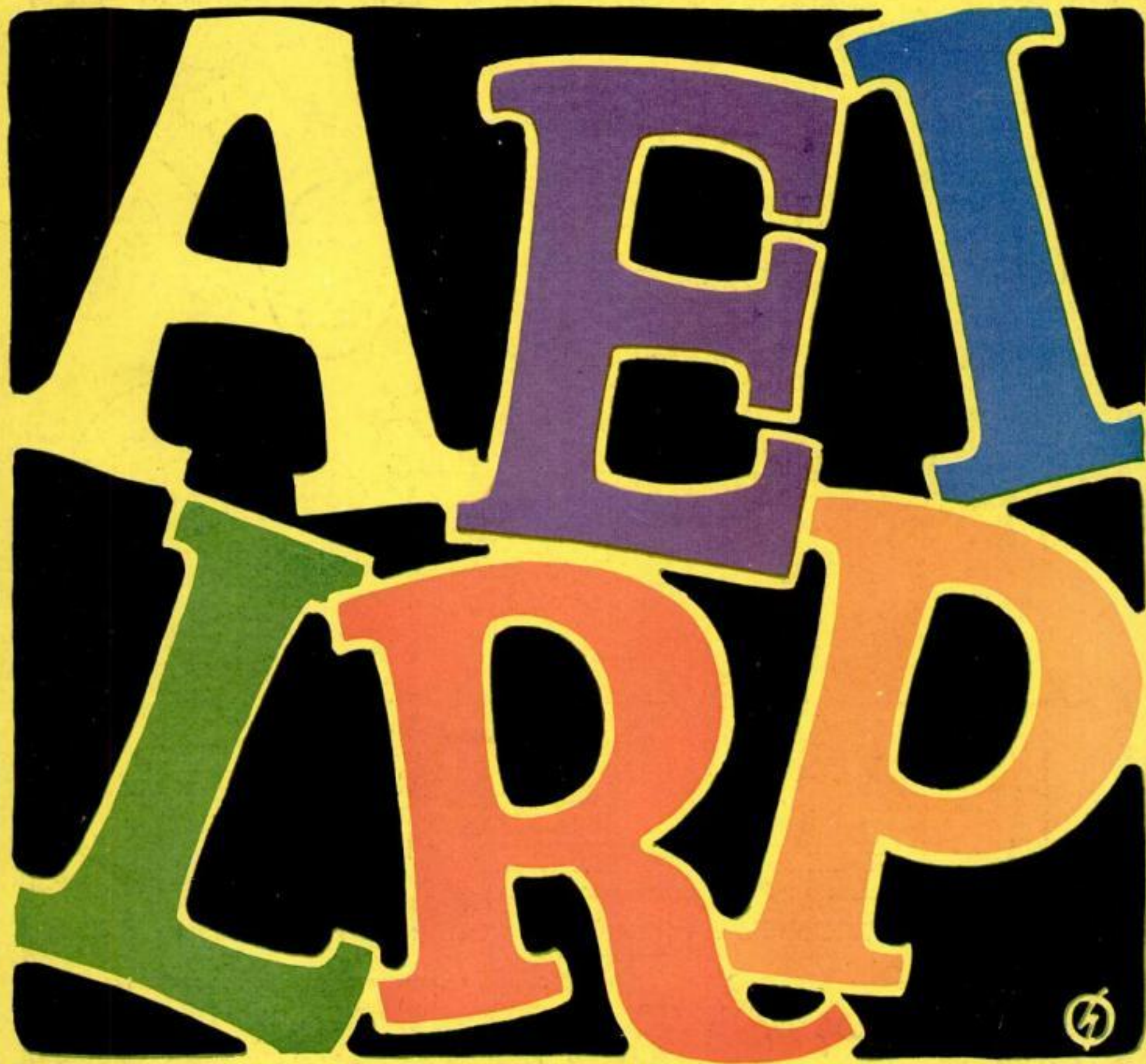


Popular Science

★ FOUNDED MONTHLY 1872

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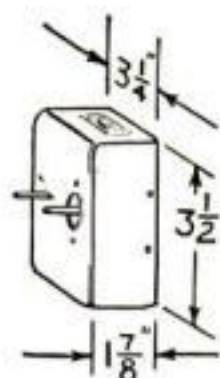
HOW FAST CAN YOUR MIND WORK ?

Five fascinating ways to test yourself — Page 12

FEBRUARY RADIO ~ INVENTIONS ~ HOMEWORKSHOP

25 CENTS

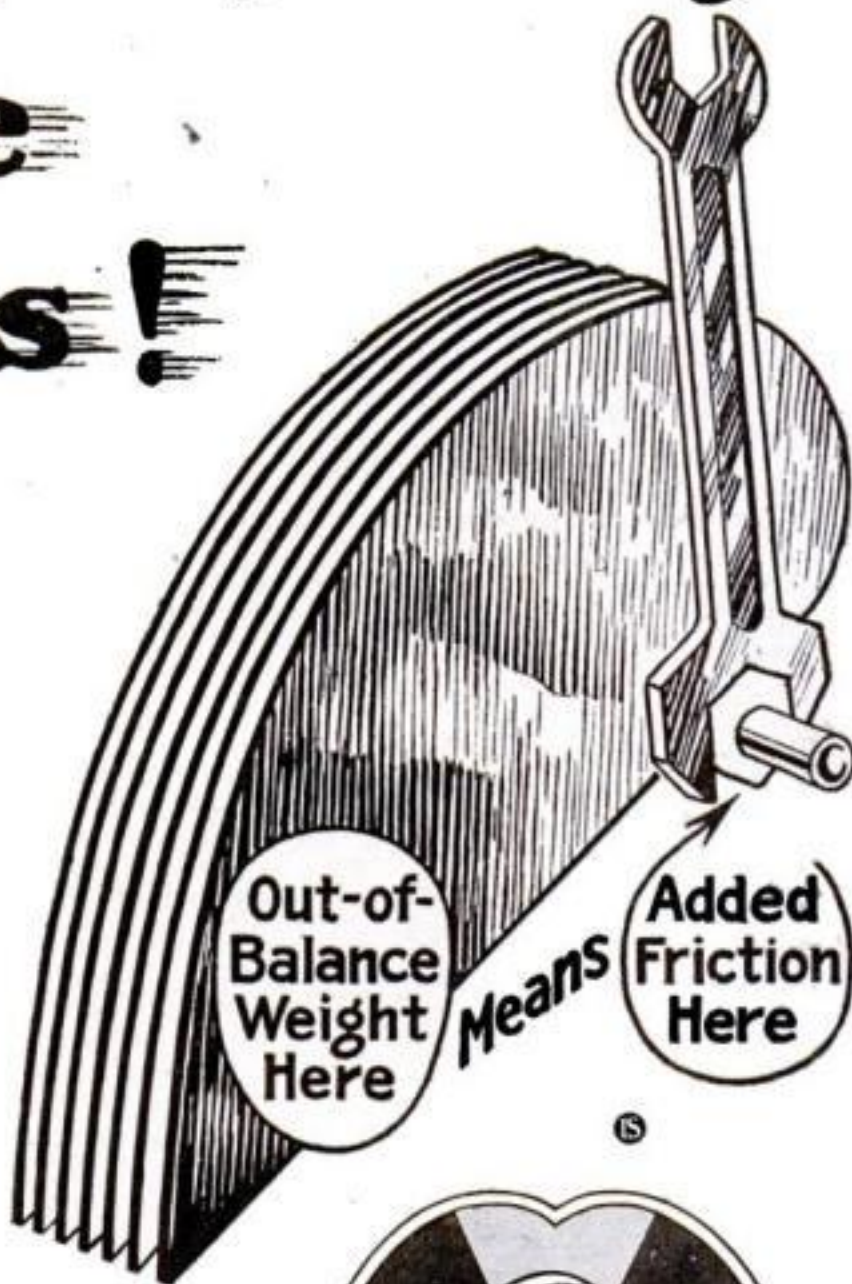
Straight-Line-Frequency Tuning Without the Brakes!



ALL-AMERICAN Condensers, with their smooth-sliding plates, (see sketch at left) require no tensioning. There is no sensation of raising a weight or letting it fall. Compactness, also, far exceeds that of rotor types. (See dimensions on sketch.) Efficient shielding prevents the touch of the fingers from affecting the tuning, and protects the plates permanently from dust or damage.

Taking full advantage of the 360° rotation, there is an ALL-AMERICAN Dial with two scales, both on the upper half, where they are always visible.

Used with the ALL-AMERICAN Toroid Coils, these Condensers space out equidistant on the dial all wave-frequency channels from 550 meters down even to 175 meters. Power and selectivity are greatly improved through the absence of stray magnetism.



ALL-AMERICAN
TRADE MARK
STRAIGHT-LINE-FREQUENCY
TUNING



see
pages

ALL-AMERICAN Straight-Line-Frequency CONDENSERS

Type C-35 Max. 350 micro-
microfarads (Min. 10.5
mmf. at 400 meters) . . . \$4.50
Type C-50 Max. 500 micro-
microfarads (Min. 11.8
mmf. at 400 meters) . . . \$5.00
Type C-40, 360° Dial . . . 1.00

ALL-AMERICAN TOROID COILS

Type T-1 Antenna Coupler . \$3.50
Type T-2 R.F. Transformer . 3.50
Set of 3 coils complete . . . 10.50
The R. F. Transformer has a
small primary, closely coupled to
the secondary, entirely air-insu-
lated. The coupler has taps for
long and short antenna. All
bases are of bakelite.

ALL-AMERICAN TRADE MARK Famous Audio Transformers



Standard Audio Transformers

3 to 1, R-12 . . . \$4.50
5 to 1, R-21 . . . 4.75
10 to 1, R-13 . . . 4.75

Power Amplifying Transformers (Push-Pull)

Input Type R-30 . . . \$6.00
Output Type R-31 . . . 6.00

Rauland-Lyric

A laboratory-grade audio
transformer for music
lovers. R-500 . . . \$9.00



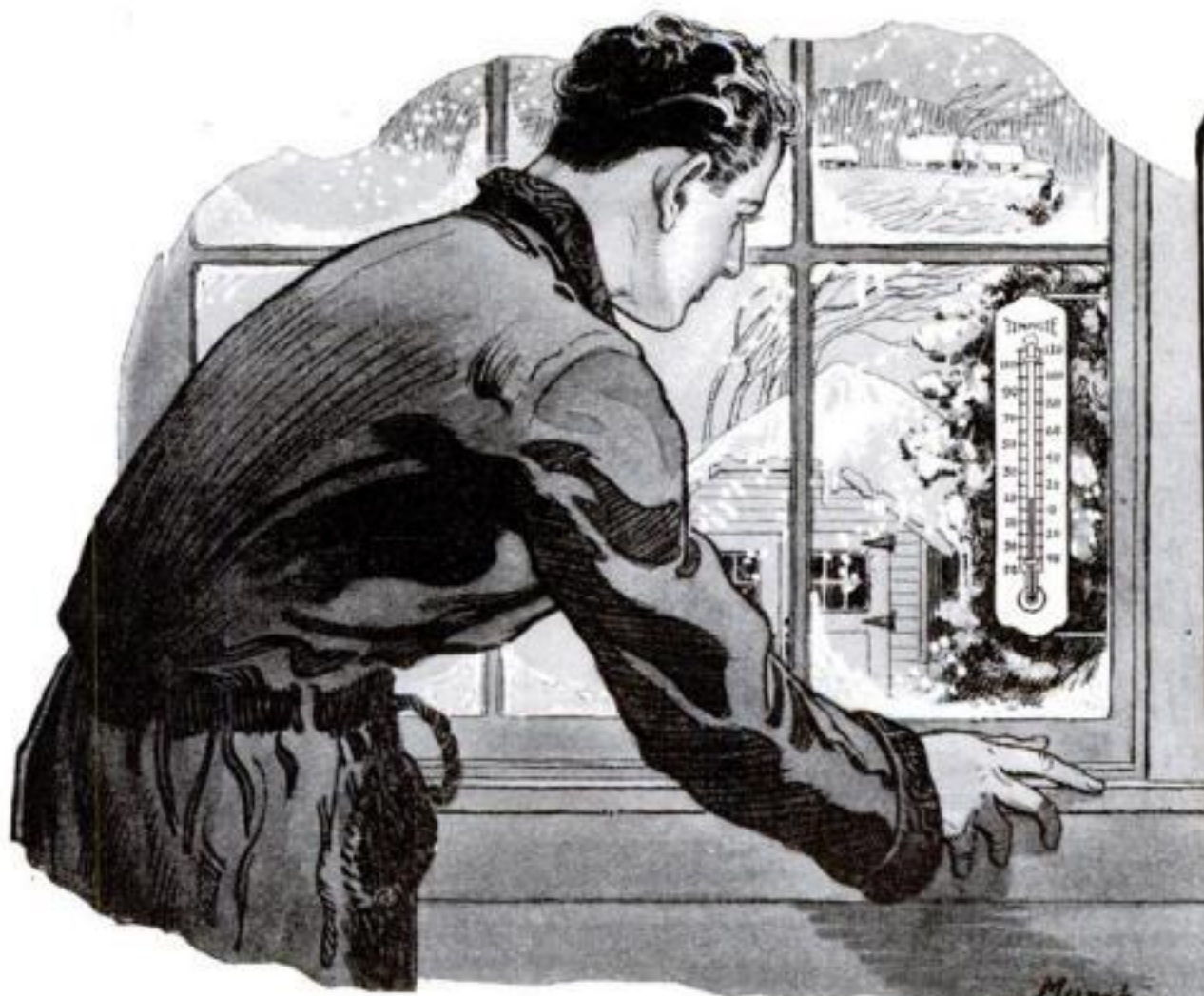
ALL-AMERICAN RADIO CORPORATION, 4215 Belmont Avenue, Chicago, Illinois
E. N. Rauland, President

RMA

OWNING AND OPERATING STATION WENR-266 METERS

ALL-AMERICAN

Pioneers in the Radio Industry



An Accurate Answer to — “How Is It Outside?”

THE surgeons of the Chemical Warfare Service say: “42 out of every 100 persons in the United States are suffering continually from colds.” Many of these colds are the result of carelessness. With a *Taylor Temprite* you can know the outside temperature without going outdoors to find out. You need not open windows or doors which cause drafts and lower room temperatures. *Temprite* tells you accurately at a glance from your warm living room or bedroom the exact outside temperature.

Because we are the largest manufacturer of all kinds of heat indicating, recording and controlling instruments, and because we are producing such a large quantity of them, we have been able to develop this reliable, outdoor thermometer to sell for \$1.00. This thermometer—the *Taylor Temprite*—registers the temperature accurately, always!

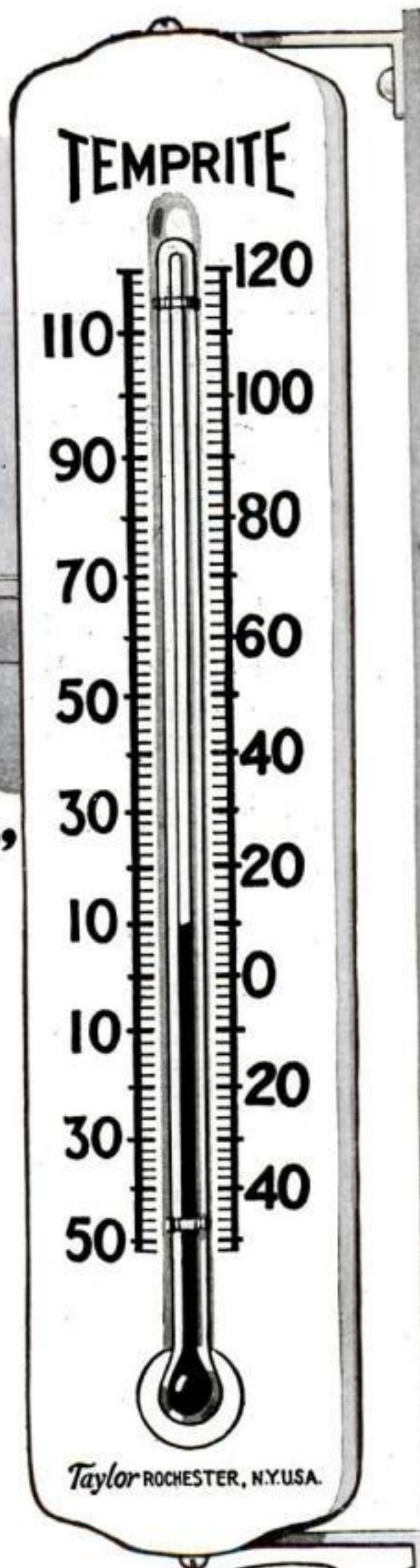
The *Taylor Temprite* is shown in full size at the right. The *Temprite* is a handsome Thermometer. The figures are stamped boldly on a beautiful white-enamelled solid metal back.

The temperature can be read at a distance of 15 feet. The fadeless, bright colored liquid is permanently sealed in a magnifying glass tube.

Included with the *Taylor Temprite* are white enameled metal brackets, bolts and nails. All you need to “put up” the thermometer is a tack-hammer. It is adjustable so it can be read from any angle.

If your dealer doesn't yet handle the *Taylor Temprite*, send your check, money order, or a dollar bill with the coupon below and we will send you one carefully packed, safe delivery guaranteed. (Please give us dealer's name).

\$1
TEMPRITE
DOLLAR WINDOW THERMOMETER



Canadian Plant:
Tycos BUILDING
TORONTO

Taylor Instrument Companies
125 AMES ST., ROCHESTER, N. Y., U. S. A.
Short & Mason, Ltd., Manufacturing Distributors in Great Britain

Taylor Instrument Companies
125 Ames St., Rochester, N. Y.

Please send me at once one *Taylor Temprite* Window Thermometer for which I enclose \$_____ I understand you guarantee safe delivery.

Name _____
Address _____
City _____ State _____
Dealer's Name _____

THE SIXTH SENSE OF INDUSTRY
Tycos Temperature Instruments
INDICATING • RECORDING • CONTROLLING

Popular Science Monthly

The Magazine of Invention and Discovery

FEBRUARY, 1926; Vol. 108, No. 2
25 cents a Copy; \$2.50 a Year



Published in New York City at
250 Fourth Avenue

Don't Miss These Features

IF YOU are one of 60,000 readers who followed John and Mary Newlywed through their home-making troubles in our great \$10,000 "What's Wrong" Picture Contest, you will be glad to know that we are presenting this fascinating young couple in a brand new contest, beginning with next month's issue. You're sure to find this new contest fully as entertaining and as helpful as the last one. One thousand dollars each month in cash prizes. Turn to page 30 and read about it.

THE most valuable thing in the world is your mind; but did you ever stop to find out just how valuable it is, how it works, and what it will do for you? On page 14, and on the cover of this issue, are a number of standard psychological tests used by experts in vocational guidance as a yardstick to fit men into the right jobs. It will pay you well to try these tests on yourself. You will find them not only entertaining, but stimulating and profitable.



Measuring the rate of air flow in a coal mine—one of the safety measures described on page 16

"WHAT about oil as a household fuel?" Probably every one of us who has been caught by the coal shortage has been asking this question. Is oil just as cheap as coal? Will it heat our homes just as well? What is the comparative cost of installation?

On page 26 an expert gives you the definite answers in terms you can read at a glance. He tells you just what you want to know about this important subject.

IN THE depths of the earth, David Jones, miner, has been digging coal for 50 years. There, where sunlight never penetrates and where fresh air is drawn in by pumps, he has found romance and adventure aplenty. On page 16 you will read of some of his interesting experiences as a coal miner. You also will learn of some of the remarkable things science is doing to safeguard the lives of the men who work at the bottom of the shaft.

ON EVERY page of our Radio Department, beginning on page 62, there's something of interest to the radio fan. Whether you build your own set or buy one ready made, you will find here expert ideas and suggestions that you can use to advantage.

And 200 Other Articles and Pictures, including—

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POPULAR SCIENCE MONTHLY

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Look about your home!

See how easily Upson Board would cover cracked, ugly plaster...replace falling ceilings...insulate attic or garage...add closet space...partitions...help you with dozens of useful household articles.



Do you like to build things? You'll be surprised how easily you can use Upson Board to make waste-baskets, table tops, cabinets, and dozens of other useful articles.



Upson Fibre-Tile comes in big panels that apply right over old wainscoting in bathroom or kitchen. When enameled it looks and wears like ceramic tile—at one-tenth the cost.

For bathrooms and kitchens. "The Upson Fibre-Tile wainscoting in our bathroom looks like the porcelain tub and fixtures." J. W. B., New Hartford, N. Y.



Upson Board is three products in one

For ceilings—there is nothing better at any price. It is not dangerously heavy like plaster or plaster-filled boards. It saves repairs—will not crack. Tests prove it harder, stiffer, stronger.

For insulating—laboratory tests prove Upson Board 10% better than plaster twice as thick. Its use adds comfort—saves fuel—enhances investment.

For sheathing—Upson Board stiffens the framework—adds warmth—and is less costly to apply. Laboratory tests prove Upson Board 25% to 200% stronger than ordinary sheathings.

Upson Board can be applied in one-third the time of plaster, without irritating muss or dirt. Once up it is easily kept clean with a damp cloth. And properly applied, it should never warp.

Mail the coupon for helpful blue-prints.



When your plaster ceilings crack or fall—nothing better than Upson Board at any price. It won't crack.



An Upsonized living room. Upson Board may be finished in any of dozens of distinctive period paneling schemes.



For insulating. "Extremely cool in summertime and comfortably warm in winter." C. F. C., Waldboro, Me.

UPSON PROCESSED BOARD

Look for the famous blue-center

for WALLS · CEILINGS · SHEATHING · INSULATION

The Upson Company
227 Upson Point
Lockport, N. Y.

Enclosed find ten cents for finished samples of Upson Board and Upson Fibre-Tile and for blue print for..... type of room

Name

Address

Opportunity Knocks 104 Times in this issue of Popular Science Monthly!

THERE'S an old saying that "Opportunity knocks only once." But it's no longer true! In this issue of POPULAR SCIENCE MONTHLY, Opportunity knocks at your door, not once, but 104 times! Turn to pages 118 to 154—our new section of "Money-Making Opportunities"—and prove it for yourself.

FOR your convenience, we have taken all the advertisements of courses of training, residence schools, sales agencies, technical books, patent attorneys, and ads of a similar nature, and grouped them in this one section. It's a section every ambitious man, every man who wants to increase his earning power, should read!

No matter what kind of work you may wish to do, you'll find it represented in these 37 pages of "Money-Making Opportunities."

If you enjoy meeting and talking with people, you'll be interested in the announcements of salesmanship training. If you have a liking for things electrical and mechanical you will want to read the ads of home-study and residence schools and technical books, teaching electricity, automotive work, and other professions and trades of this kind. If you want to rise high in the business world, the courses in accounting, business principles and administration, will appeal to you.

But remember—merely reading these ads won't get you anywhere. You must act! Choose the training that attracts you most, and clip the coupon or coupons for full particulars. Get all the facts about your chosen field. Learn what others have done. Learn what training will do for you. Then you will be in a position to decide which course will help you most, and through that course, you can fit yourself for bigger pay and a brighter future!

\$100 in CASH PRIZES

For the best letter of 150 words or less answering the question—

"What advertisement in the 'Money-Making Opportunities' Section interests you most—and why?"

we will pay on March 10th, the following—

CASH PRIZES

First Prize	\$50.00
Second Prize	25.00
Third Prize	10.00
Fifteen Prizes	
of \$1.00 Each	15.00

First read every advertisement in the Money-Making Opportunities Section on pages 118 to 154. Pick out the one that interests you most and then write a letter—not exceeding 150 words—telling us why you find the advertisement you have selected the most interesting.

Entries for the contest will close on February 1st. The prize winners and their letters will be published in the April issue of POPULAR SCIENCE MONTHLY.

Address your letter to

Contest Editor

MONEY-MAKING OPPORTUNITIES
POPULAR SCIENCE MONTHLY
250 Fourth Ave., New York

How POPULAR SCIENCE Helps You Win Success

The "Money-Making Opportunities" Section of POPULAR SCIENCE is the meeting place for those who need training and those who are experts in giving it.

Every advertisement in this section is a real opportunity—an opportunity to make more money, to step out of your "blind-alley" job. Remember as you look through these pages that thousands and thousands of readers have found their opportunity in ads just like these. Hundreds more will cash in on the opportunities that are being offered this month. Why shouldn't you be one of them?

This issue of POPULAR SCIENCE can be just the means of passing an idle hour—or it can be the open door to success. Which will it be for you?

Don't be robbed of success because you lack the proper training, or because you failed to take advantage of the opportunities offered you. Surely, among the 104 "Money-Making Opportunities" in this magazine, you will be able to find just the right one for yourself.

Turn now to pages 118 to 154, and spend the next hour looking over these opportunities and deciding on your future career. It will be the most profitable hour you ever spent!

Your Opportunity is NOW! [SEE PAGES 118-154]

Radio That Charms Both Ear and Eye



The Kolster Eight pictured above is one of five beautiful models, of which there are two Eights and three Sixes. Each is housed in a cabinet of rare charm, designed by leading authorities. A Kolster is a pleasure to the eye as well as to the ear.

A Parade of Stations

One station after another parades by as you turn the Kolster regulator. No meaningless combination of numbers, but the actual names of the stations.

Whatever is on the air comes in easily, perfectly.



Kolster Radio brings a new and rare combination of perfected reproduction and fine cabinet work. F. A. Kolster and Elsie de Wolfe collaborate.

KOLSTER RADIO owes its hidden magic to the many achievements of F. A. Kolster, the noted scientist.

His accomplishments in tonal perfection are the sensation of the radio world.

Kolster Radio owes its exterior charm to Miss Elsie de Wolfe, the world's foremost authority on furniture and related decorations.

Her masterly knowledge brings to every home possessing a Kolster a piece of furniture of harmonious beauty.

Thus the F. T. C. Organization, pioneers in radio development, gives the public the very ultimate in radio enjoyment.

A set which delights the eye as well as the ear!

A set so simple to operate! No dials. Just turn from one station to another by name.

A single control. No charting of complicated numbers.

Full, rich, natural reproduction. Amazing clarity. The hitherto "Lost Chords" now developed—rich, clear.

All the delicate shadings, the individuality of musician or speaker—*actuality!*

No muffling. No interference. No exaggerations or repressions.

A Kolster neither adds to nor subtracts from broadcasting.

Vivid. Lifelike. A surprising thrill awaits you.

Hear this final-type radio in your own home or at a Kolster dealer's shop.

Learn how Kolster Radio differs from anything you've heard or seen before.

Then, like others of discrimination, you'll appreciate the efforts of the F. T. C. Organization in giving you the genius of F. A. Kolster, Elsie de Wolfe and other authorities. De luxe radio at everyday prices.

FEDERAL TELEGRAPH COMPANY
(of California)

Woolworth Building, New York City

KOLSTER RADIO

Popular Science Institute and the Service It Offers You

Confronted by many makes of radio sets, the prospective purchaser is at a loss. The Popular Science Institute's List of Approved Products will help you to buy wisely

APPROVED SETS

ACCESSORIES

PARTS

The Answer to "WHICH RADIO SET SHALL I BUY?"

BUYING a radio set is like picking a second-hand car—you don't know what you are getting! Unfortunately, there is a lot of truth in this statement, which was overheard recently by a member of the Popular Science Institute staff.

Two passengers on a commuters' train to New York were engaged in a discussion of the difficulties and pitfalls involved in purchasing a radio receiving set. Both had sets that were giving only fair service; both knew just enough about radio to know they wanted thoroughly efficient receivers when they made their second purchase. Neither knew how to go about getting what was wanted.

The member of the Institute who was "listening in" on this conversation had difficulty in overcoming the desire to present the two fellow commuters with copies of the List of Approved Products of the Popular Science Institute of Standards. It would have been a kind act. For, with this list as a guide, the two prospective purchasers could not have gone wrong in making their selection of radio apparatus.

This directory of approved equipment contains only the listing of those products that have passed rigid laboratory and practical tests made by the Popular Science Institute's staff of expert radio engineers. These tests are conducted in the Sage Research Laboratories at New York University, under the direction of Professor Collins P. Bliss. Besides being Director of the POPULAR SCIENCE INSTITUTE of Standards, Professor Bliss is Head of the Department of Mechanical

Engineering and Director of Testing Laboratories at New York University.

"Just what do you do to determine whether a set is good or not?" a question the Institute often is asked. Lack of space and the necessity of going into technicalities prevent us from giving a full description here. However, an idea of the thorough and exact nature of these tests can be gleaned from the following description of part of the tests.

In the first place, the receiver is subjected to four major laboratory tests. By these tests the following points are scientifically determined:

1. Effective tuning range of the receiver
2. Oscillating range of the receiver
3. Plate and filament circuit currents
4. Sensitivity and selectivity

Quantitative measurements at three standard wave lengths of the "apparent" sensitivity and selectivity of the receiver under test are obtained by impressing upon the aerial a completely modulated signal from a local oscillator that is adjusted to a standard radiation.

The total output signal intensities for the various test conditions are measured on a thermo-millimeter connected with the set output terminals through a special output transformer. The primary impedance of this transformer at modulating frequency is equivalent to that of a standard speaker.

Then there are tests to determine the ease and stability of operation, the quality of reproduction of the receiver, etc. The results of all these tests are weighed carefully and are the basis for the Institute's approval or disapproval.

The two commuters, who had the pick of New York's great radio stores and did not know which set to choose, could have solved their problem by using the Popular Science Institute of Standards' list of "blue ribbon" equipment as a buying guide. There are many others who are in a similar predicament and who will want to take advantage of the Institute's service. Inquiries and requests for the List of Approved Products should be addressed to POPULAR SCIENCE INSTITUTE, 250 Fourth Ave., New York City.

Send for Approved Tool and Radio List

POPULAR SCIENCE Monthly Guarantee

The above seal on an advertisement indicates that the products referred to have been approved after test by the Popular Science Institute of Standards.

Popular Science monthly guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in Popular Science Monthly may expect that these products will give absolute satisfaction under normal and proper use. Our readers in buying these products are guaranteed this satisfaction by Popular Science Monthly.

THE PUBLISHERS.



give your radio set more power with one new Radiotron



RADIOTRON
UX-112
\$6.50

RADIOTRON UX-112
The new storage battery power Radiotron UX-112 may be used in sets that use Radiotron UV-201-A.

RADIOTRON UX-120
The new dry battery power Radiotron UX-120 may be used in sets that use Radiotron UV-199.

You would not use any but a Mazda lamp in your lighting circuit. Why use any but an RCA Radiotron in your radio set? They are made by the same skilled workers, backed by the same research laboratories. But the Radiotron is far more delicate to make.



RADIOTRON
UX-120
\$2.50

RADIO CORPORATION OF AMERICA — NEW YORK — CHICAGO — SAN FRANCISCO

RCA Radiotron

MADE BY THE MAKERS OF RADIOLAS



"These Eveready Batteries are the correct size for your set. With average use they will last you a year or longer"

"You have been one of the many who use 'B' batteries that are too small in capacity for their receivers. That is not economical. It makes you buy 'B' batteries twice as often as necessary. Fit the right size Evereadys to your set and add a 'C' battery,* if you haven't one, and you'll get the maximum of service at the minimum of cost."

The life of your Eveready "B" Battery depends on its capacity in relation to your set and how much you listen in. We know, through a careful investigation, that the average year-round use of a set is

two hours a day. Taking that average we have proved over and over that on sets of one to three tubes the No. 772 Eveready "B" Battery used with a "C" battery will last a year or longer. On sets of four and five tubes, the larger Heavy Duty Eveready Batteries used with a "C" battery will last eight months or more.

Here is the secret of the "B" battery satisfaction and economy;

With sets of from 1 to 3 tubes, use Eveready No. 772.

With sets of 4 or more tubes, use either of the Heavy Duty Batteries, No. 770, or the even longer-lived Eveready Layerbilt No. 486.

We have prepared for your individual use a new booklet, "Choosing and Using the Right Radio Batteries," which we will be glad to send you upon request. This booklet also tells about the proper battery equipment for use with the new power tubes.

Manufactured and guaranteed by
NATIONAL CARBON CO., INC.
New York San Francisco
Canadian National Carbon Co., Limited
Toronto, Ontario

EVEREADY HOUR
EVERY TUESDAY AT 9 P. M.
Eastern Standard Time

For real radio enjoyment tune in the "Eveready Group." Broadcast through stations—

WEAF—New York	WFI—Philadelphia	WSAI—Cincinnati
WJAR—Providence	WGR—Buffalo	WWJ—Detroit
WEEI—Boston	WCAE—Pittsburgh	WOC—Davenport
WTAG—Worcester	WEAR—Cleveland	KSD—St. Louis
WCCO—Minneapolis, St. Paul		WGN—Chicago



*NOTE: In addition to the increased life which an Eveready "C" Battery gives to your "B" batteries, it will add a quality of reception unobtainable without it.

Keep Your Mind Young

AN EDITORIAL

THE father, smug and satisfied, was speaking. The son, animated and imaginative, listened attentively. About us was the noonday clatter of a big restaurant.

"And you believe you can can the heat of the sun? Absurd! Why, you are only twenty-one years old and experts haven't been able to do it!"

My friend has the wrong attitude. His intolerance is cheating his boy of a rightful share of that youthful vision of achievement that is the hope of the world's future.

People, including experts, once said it was absurd to try to can the human voice. Yet Edison, in his twenties, invented the phonograph. Some day some one will can the sun's heat. It may be my friend's son. It may be your son. And it may be my son.

BACK in my office that father read the story of Alexander Graham Bell as it appears in this issue. At 28, Bell, a teacher of the deaf, invented the telephone. Experts, unable to keep their minds young, had called his idea, "nonsense."

Together we looked up the story of a millhand of 26, Elias Howe by name. Experts told him that there was only one place to put the eye of a needle—at the end opposite the point. Howe put it at the other end. The result is the sewing machine.

An expert is one who has a thorough knowledge of the accepted way of doing a thing. And sometimes rou-

tine blinds people to possibilities. Impetuous youth, unhampered by tradition, knows no such restraint.

AT 24, Watt demonstrated the steam engine. McCormick at 21 gave us the reaper. Einstein at 26 propounded his theory. Pullman invented the sleeping-car at 27, and Whitney the cotton gin at 28. These were just a few of the names we mentioned.

The courage of youth carried these men to success over ice too thin for intolerant experts. Fearless of ridicule, they sought new and untraveled paths. Youth has always been the adventurer and the pioneer.

Resistance of that which is new means the loss of elasticity and receptivity. It means that imagination, without which there can be no accomplishment, is dead.

All of this, and more, I said to my friend. For he is stifling something divine the Creator put into his boy. But as he left me he just smiled a satisfied smile and said:

"MAYBE so, maybe so. But suppose he does can the sun's heat. How many want a sun engine when they can get a steam or a gas engine?"

And I thought of the British Government's reply, in 1823, to an application for a test of an electric telegraph.

"Telegraphs of any kind," it ran, "are wholly unnecessary. None other than the semaphores now in use will ever be needed."—S. N. B.

Imitation

—the Sincerest Flattery



Grebe
Binocular Coils
Reg. U.S. Pat. Off.
and
Low-wave
Extension
Circuits



A

B

The high-wave reception range of the Grebe dial (B)—from 550 down to 240 meters—equals the practical tuning range of the usual receiver. The low-wave range of the Grebe dial (A) provides additional reception down to 150 meters.



Grebe "Colortone"

Usual
Dial

Grebe
S-L-F
Condenser



Flexible Unit Control



"Take the lead and
set an example of dili-
gent toil."
—Confucius

Much toil and great diligence have made
the Synchrophase worthy of first rank in
radio receivers.

Doctor W. H. A.

LAST year Grebe developed the fieldless
Binocular Coils and S-L-F (straight line
frequency) Condensers.

These Grebe developments have now been
adopted on a number of other receivers.

This year Grebe has devised the *Low-Wave
Extension Circuits*, "*Colortone*," and *Flexible
Unit Control*. It will be interesting to see how
soon these, too, are added to other sets.

In buying a Grebe Synchrophase now, you will
have advances in radio construction, such as
other receivers will probably show next season.

*Ask your dealer to demonstrate
all these Grebe developments.*

A. H. Grebe & Co., Inc., 109 W. 57th St., New York
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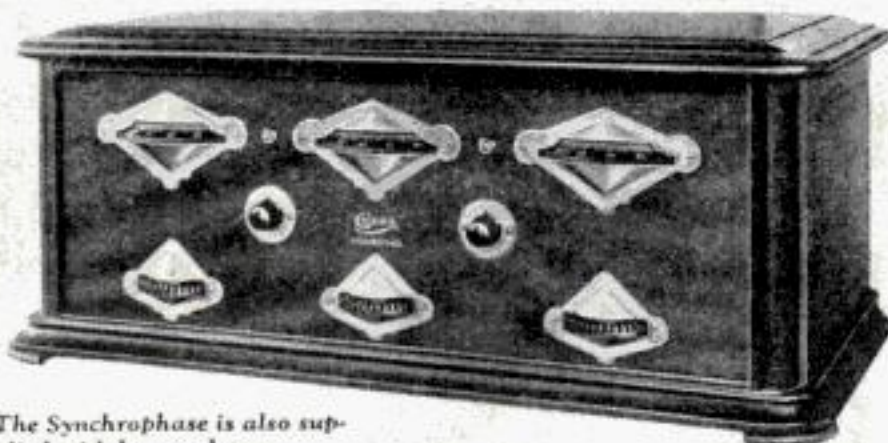
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The GREBE

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New Wasp-Planes Look Like Toys, but Spit Death

Army airmen practise for combat with miniature machines and floating targets—How an aerial sharpshooter can bring down every one of a flock of birds—1000 bullets a minute fired through the whirling blades of a propeller—A remarkable story of our deadliest air engines

By Corley McDarment

A SHORT time ago, people who live near the salt water district of the Virginia peninsula between the York and the James rivers heard an unusual sound in the sky. They were accustomed to hearing the noise of airplanes. The Army, Navy, and Marine corps all have had flying fields in that vicinity. But this noise was different.

Up in the sky a swarm of tiny yellow machines were seen darting about with incredible speed. "And the racket they made," said a fisherman later, "was awful—made you feel creepy, like something terrible was coming on. They nearly jarred your teeth out when they went directly overhead."

It was the First Pursuit Group of the Army Air Service indulging in gunnery practice while on its way from New York to its home station in Michigan via Washington, D. C.

And the peninsula folks saw and heard more astounding things a few days after the wee machines made their appearance. They saw, for example, a little group of these tiny planes, that roared so loudly, one morning sweep upward in a steep spiral, like a bedspring, until they became mere specks among the wisps of broken clouds. Nobody there ever had seen airplanes climb so fast or so far.

When they reached the clouds, the planes began to string out. One started a dive toward the marshes

near Back Bay. As it gained speed under full throttle, the hum of the motor arose to a deafening bombardment; the wires screamed shrilly. Then, as the machine approached the ground, there issued from it suddenly a steady rattle of machine-gun fire. The plane dived to within 50 feet of the ground, then turned its nose upward and climbed almost back to the clouds on the propeller. Following this first plane, came the second, the third, fourth, and the others, each performing exactly the same maneuvers.

Reforming their "ranks" just beneath the clouds, the planes assumed a V formation like a flock of wild geese, and cruised

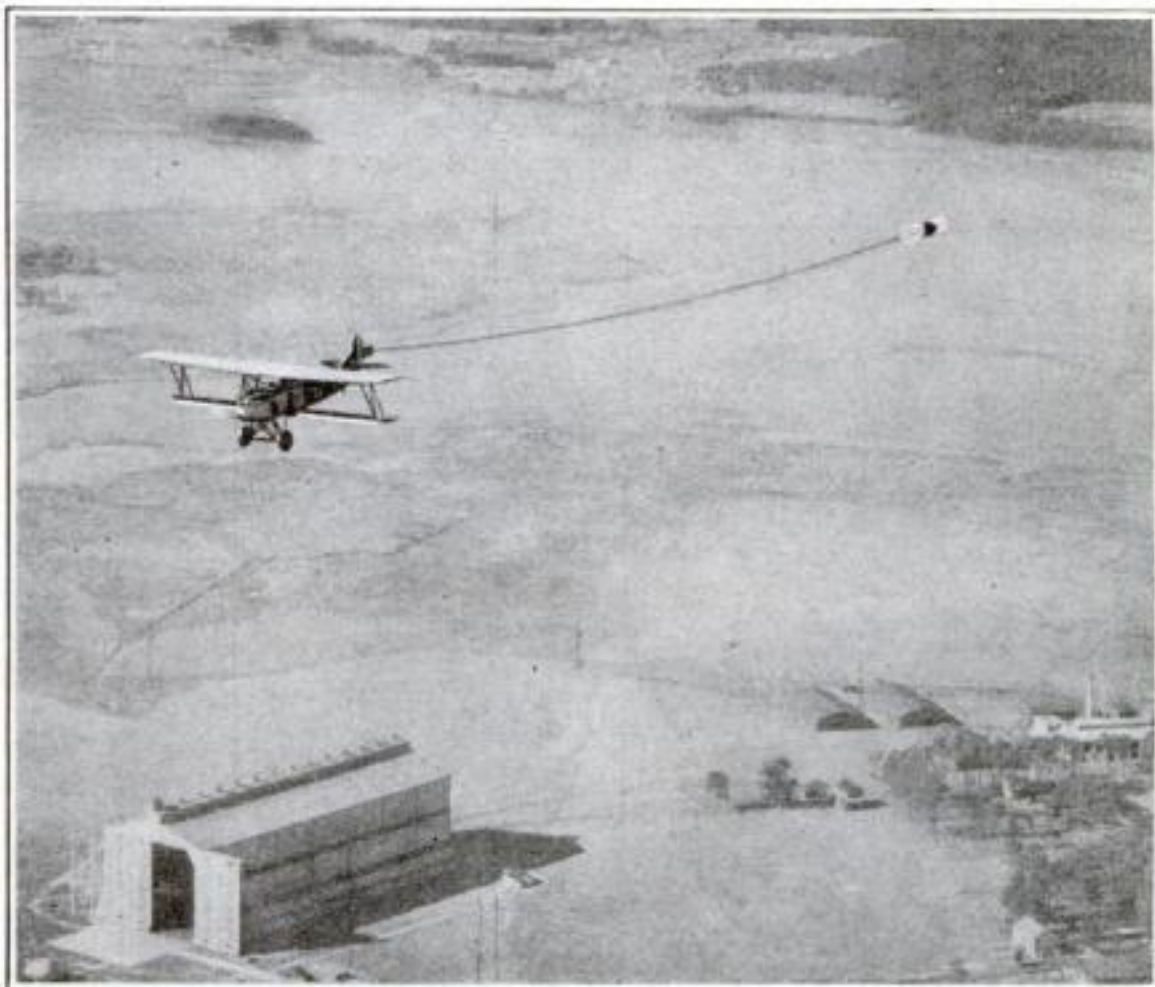
about in various evolutions for a few minutes. Presently, from the flying field, a larger plane of the observation type flew diagonally across the path of the formation until it was between the small planes and the open water of Back Bay. From behind this large plane a little white object suddenly moved out in a straight line. It crept back without losing altitude until it hung at about 2000 feet. Then it followed the big machine across the sky.

When the little white object began to move toward the big plane, the formation of pursuit planes broke from its V and assumed a single file that resembled a huge snake. The leading plane shot toward the white speck, and the loud, quick bark of a machine gun again rent the air.

Straight at its moving target darted the little plane. Just as they appeared about to collide, the machine gun fire died, the plane slackened speed and performed a loop around the target. Facing the white speck again, the pilot resumed his machine gun fire.

When the plane and target seemed about to meet this time, the former made a short dive and appeared about to make another loop. Instead of completing this maneuver though, it made a quick flip while on its back, turning right side up.

This little "stunt," the "Immelmann turn," had changed the direction of the plane and left it higher



A Floating Target for Swiftly Flying Marksmen

An army biplane towing an aerial target for machine gunners of pursuit planes. While such a target, floating some 400 feet at the rear of the plane, cannot duplicate the conditions of actual combat, it does provide valuable means for practice to the aerial marksmen

than it was before. From this higher altitude, the pursuit machine made a sideward dive and as it shot past the target, it let out several bursts of machine gun fire. From the lower altitude, the attacker banked vertically around on the point of one wing, straightened out, and once more started upward at a steep angle, firing as it climbed.

One at a time the other planes went through practically the same maneuvers. Then they reassumed a V formation and went streaking across the sky in the direction of the airdrome. The target was wound in, and the plane that carried it also started toward the flying field.

TO OBSERVERS, the performance was just a show. To the aerial actors who put on this and other similar performances, though, such maneuvers have a grim significance. For these men are practising against the day when they may be called into action at a few hours' notice and compelled to engage in actual combat with enemy aircraft that swarm toward American shores laden with bombs of explosives, poison gas, and liquid fire.

Very different would this actual fighting be from shooting at a white rag towed lazily across an evening sky. But in this kind of practice "live" targets obviously cannot be used. The towed target, at least, offers something to shoot at, something to dive at and maneuver against. For the aerial marksmen it is quite as useful as is conventional target practice for soldiers of the ground forces. For it affords practice that supplies the skill needed for actual combat.

The pursuit air fighter, however, must acquire a much finer skill than his brother combatant upon the ground. The airman must turn his whole airplane to use his machine guns, for these shoot through the blade of the propeller. But so mobile are the latest type of pursuit planes that turning and aiming the craft is scarcely

more difficult than swinging a rifle or shotgun from the shoulder. In the words of one pursuit pilot:

"All you have to do to loop her is just think about it."

The air fighter must be able to shoot while standing upon his head, hurtling through a barrel roll, or loop, diving, or standing upon his tail.

"Standing upon the tail" is the way aviators express the position of a plane that is pulled up almost straight and

shot at random through the blades of the propeller, which were protected by heavy strips of metal to deflect the bullets.

This method was unsatisfactory generally. It necessitated turning the propeller slowly; also it deflected many of the bullets. But eventually, under the press of necessity, a way was found to time firing through the blades so that the bullets always would clear the blades.

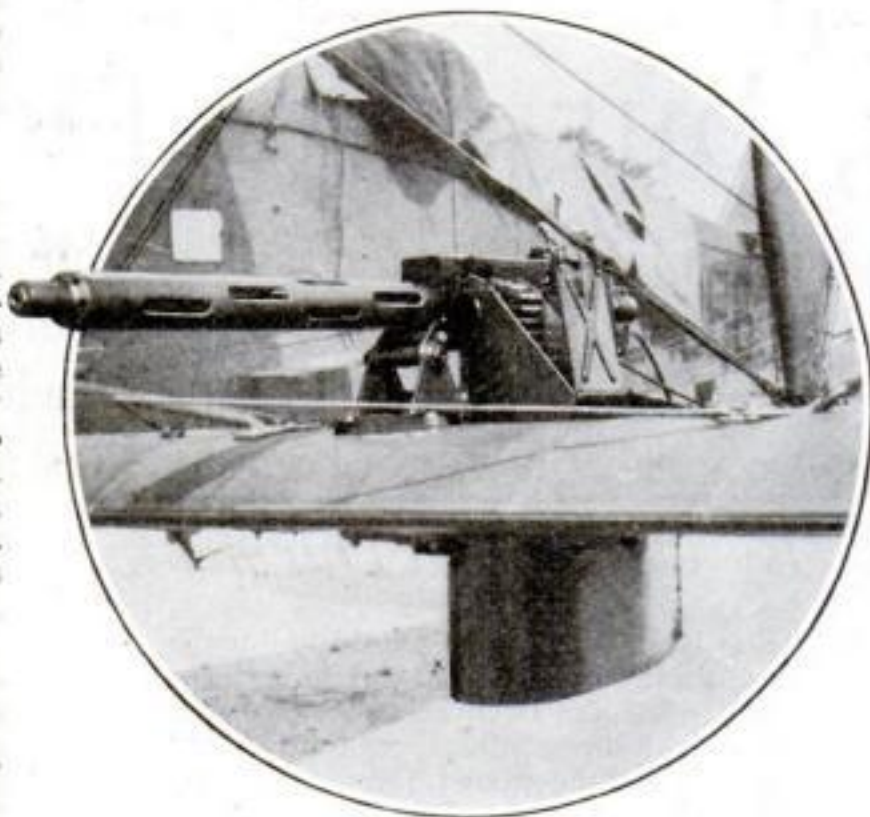
This timing depends upon the kind of gun, ammunition, and airplane used. At first, with guns firing 500 times a minute, while the propeller made 1400 revolutions, it was effected by setting the "interrupter gear" so that the gun would fire when it was pointing exactly at the center of the blade of the propeller. Then by the time the bullet, traveling at the rate of 2700 feet a second, arrived at the point where the propeller blade had been, the space was clear for "full speed ahead."

WITH motors twirling propellers about 2200 times a minute and machine guns firing at the rate of 1000 shots a minute, the synchronizing ratio is a little more complicated, but the principle is the same.

Recently, there has been developed a device known as the "target glider." The gliding target is a miniature airplane that is released from a carrier plane at great altitudes, and as it glides, spins, or does a natural "falling leaf" toward the ground, the aviators have a livelier mark to shoot at.

This target glider is a sort of third step in the training of aerial gunners. The first is the towed target, the second is bursting, floating toy balloons.

Some aviators develop into crack shots from this form of practice. An expert aerial machine gunner can bring down every one of a flock of wild geese. A few aviators insist that shooting wild birds affords valuable practice for warfare, but the majority hold that such practice is useless as a training for combat.

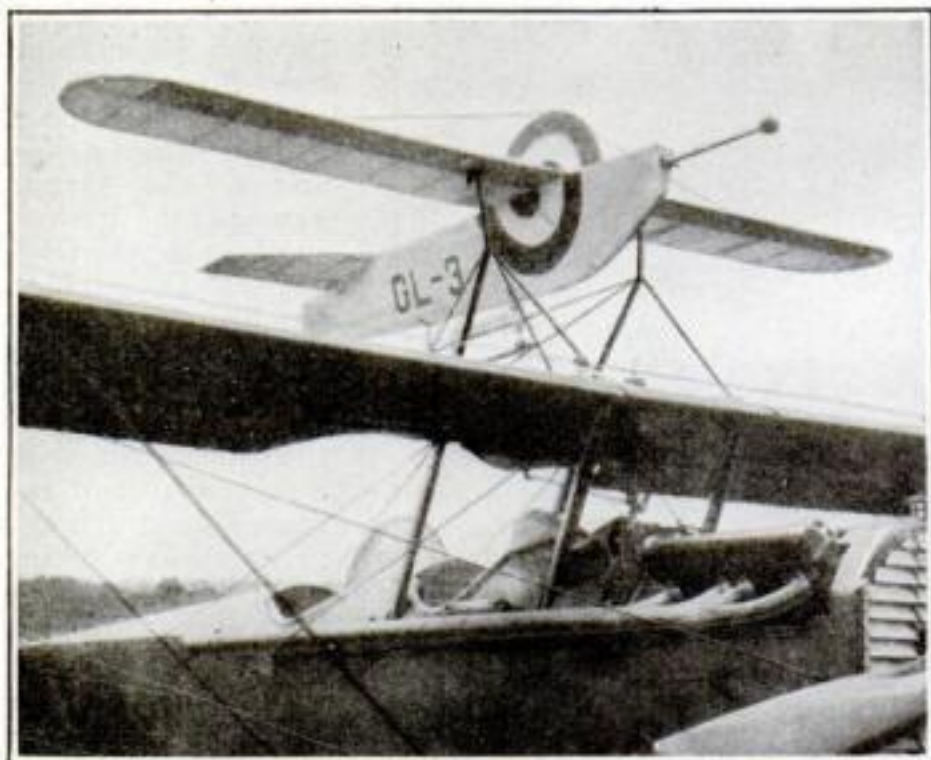


The Wing Gun of a Sky Dreadnaught

In striking contrast to the wasplike pursuit planes described in this article, there are being developed great dreadnaughts of the sky capable of tremendous destruction in time of war. This picture shows how a machine gun is mounted on the wing of one of these giant planes. Note the cockpit for the gunner

hangs upon the propeller while a stream of bullets is poured upward into an enemy. This was a favorite method of attack during the last days of the Great War. There is an area directly beneath pursuit planes which the pilot cannot see and his enemies seek to creep into this space and unload a drum of straight and incendiary bullets into the gasoline tank.

When the airplane was used first as a weapon of war, the machine guns were



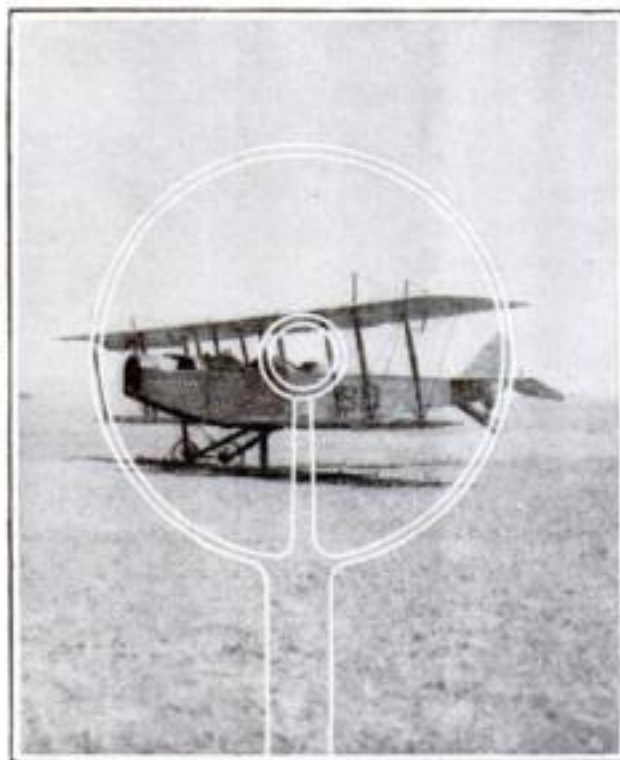
The Target Glider—A Lively Mark for Gunners

A target glider on the top wing of a carrier plane. Released from a high altitude it provides a lively mark for pursuit aviators as it rapidly glides, spins, or does a "falling leaf" toward the ground



Ninety-Seven Rounds

The ammunition drum of an aerial machine gun. It holds 97 rounds. Bullets are fired through the airplane propeller with which the gun is timed



Getting the "Bead" on a Pilot

How the "bead" of a machine gun is drawn on the pilot of another plane—a guide to marksmanship used by the aviation corps

How *Fast* Can Your Mind Work?

Five Fascinating Tests that Will Help You to Measure and Classify Your Own Ability

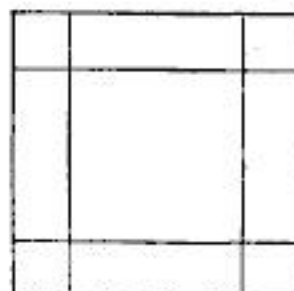
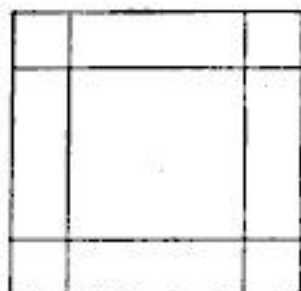
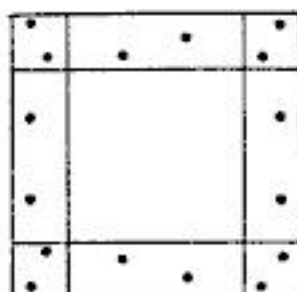
ON THESE pages are five fascinating tests, designed to measure and improve your mind. Certainly you would like to know how fast and how well your mind works; it will be of inestimable value to you to learn in what direction your mind operates best; that is, just what your especial talents are and in what line of work you are most likely to excel.

These tests have been arranged by Dr. Albert Johanson, of the Department of Psychology, Columbia University, according to the methods used by scientists in measuring intelligence and guiding young men and women in choosing their life work. The tests are like a fascinating game. You will enjoy taking them; you will find them refreshing and stimulating to your mind.

Have you ingenuity? Ingenuity is the mark of the inventor, of the resourceful man who bends circumstances to his own ends. The test at the top of this page will enable you to measure the adroitness and elasticity of your mind. If you possess this useful quality to a marked degree, you will find the test simple. If you are not ingenious to an especial degree, you will find it more difficult. In the latter case there is nothing to worry about. Your ability may lie in another direction, a

fact that the other tests will quickly point out for you.

Do you perceive things swiftly, clearly, and accurately? Would you make a good witness in court? Do you, in short, see all that you look at? Can you concen-



A Test of Ingenuity

In the uppermost figure are 16 dots. The total number of dots on each side, counting both corners each time, is six. Can you place 16 dots in the lower left-hand figure so as to have seven on each side? Can you place five dots on each side of the right-hand figure and make a total of 16 just as before?

trate and stick to a job, or do you tire easily? Try the second test and learn for yourself.

Are you imaginative? The man who has imagination has ideas; he thinks of things in new ways. Imagination is the fountainhead from which has sprung all human progress. Men of imagination have made all our great inventions, painted our great pictures, written our masterpieces of literature, established our great industries. Successful men in business, industry, the professions, indeed, in all human activities, invariably are men of powerful imagination.

On the cover of this issue is a test of imagination. It is reproduced at the top of page 14. Take out pencil and paper and try it. Your score in the test will supply a trustworthy index to your imagination.

Possibly numbers, mathematics, is your forte. The next test—the coin test—will tell you that. If you have a “head for figures,” this test ought to be the easiest of all for you.

Or it may be that you possess a sense of form that points to the likelihood of your winning success in some artistic calling, or through the practice of highly developed skill at some manual pursuit. The test at the bottom of page 14 will tell you that, quickly and surely.

5 1 6 8 4 9 2 3 7 0 1 2 7 5 0 4 8 6 9 3 4 1 8 9 0 2 5 6 3 7 1 7 5 6 0 8 9 2 4 3 7 8 6 9 0 4 3 1 2 5
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5 2 1 3 4 0 9 6 8 7 3 4 2 9 8 0 6 5 7 1 7 3 6 5 2 0 9 8 1 4 3 9 6 8 4 0 5 7 2 1 0 7 3 2 9 4 8 6 1 5

Take out your watch and note the time, then draw a line through every 0 in the group of numbers above. How long did it take you to do this? Write that down, and after you have completed all tests, turn to page 133 and learn your rating in the test

The tests here given are the first of a series that Doctor Johanson has selected for the readers of POPULAR SCIENCE MONTHLY. In succeeding issues he will offer you other tests that include the entire range of mental activity. To obtain maximum benefit from this unique series, you should complete all the tests and obey all the rules. Then you will have an accurate measure of your mind, and will find your mental powers have been sharpened and invigorated by these interesting exercises.

Not only will these tests be mentally stimulating, but as pointed out above, they will discover in what direction your mind moves most quickly. In other words, where your talents will shine to the best advantage.

There is a great deal of satisfaction to

Have You Imagination?



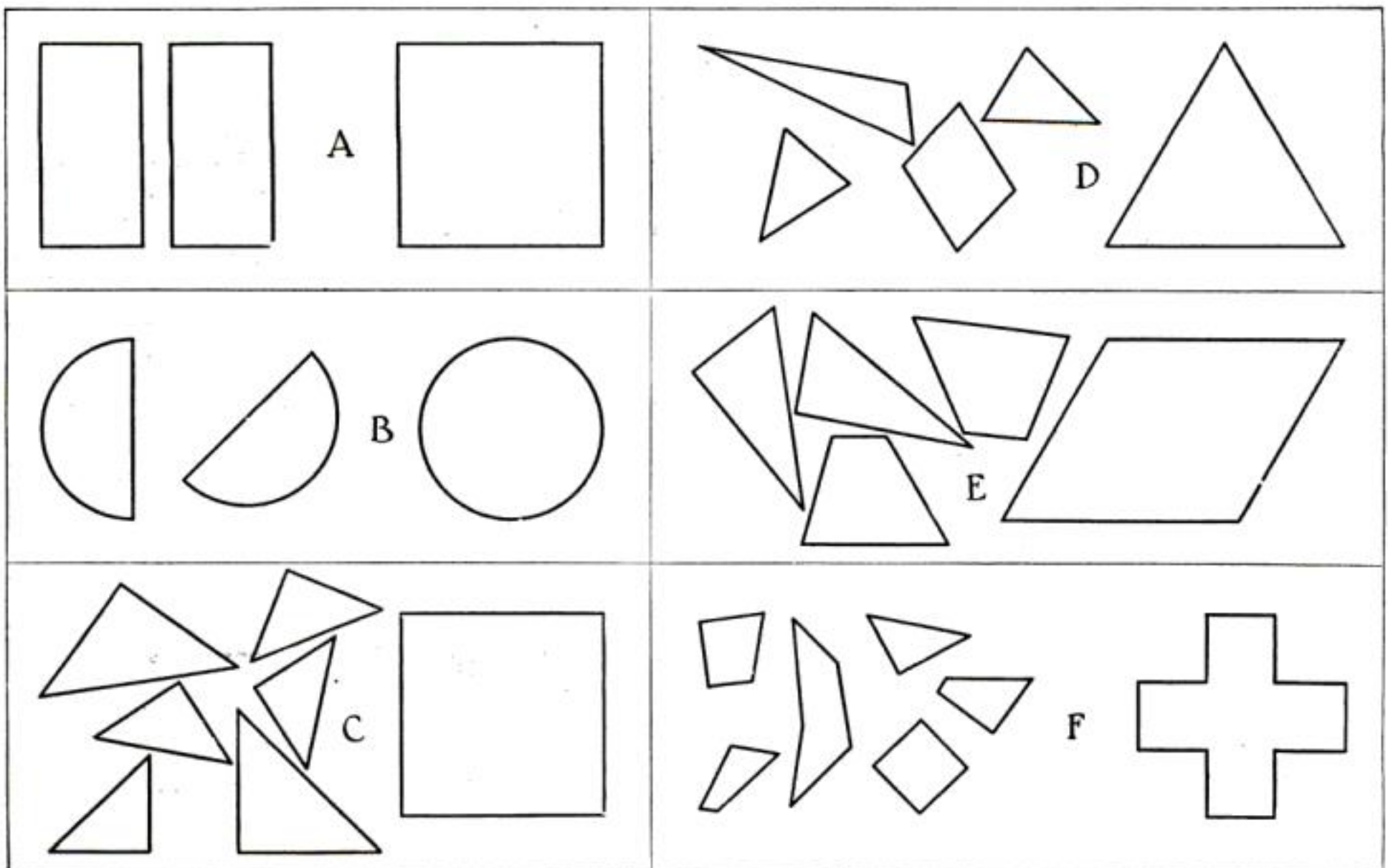
How many words can you make of the six letters above in five minutes? You may use each letter only once in each word. Turn to page 133 when five minutes are up and find your rating

be had from such a discovery. Also it is especially important when everyday competition in the workshop, the office, and the arts becomes keener and keener. Knowing that you have analyzed your powers by such tests as are offered here, and by constant observation of your daily reactions to phases of your work, will give you added confidence in everything you do.

So look upon this series of tests not merely as an intelligent game. Look upon it as something that will make you more useful as a human being and a valuable cog in the great wheel of progress. The solutions of the test, from which you may obtain your rating, are printed on page 133. Do not, however, look at the solutions until you have completed all five tests.

1.	What 3 coins add up to 20 cents?	.....Halves	.....Quarters	.....Dimes	.....Nickels	.....Pennies
2.	" 4 " " " 28 "	.....Halves	.....Quarters	.....Dimes	.....Nickels	.....Pennies
3.	" 5 " " " 27 "	.....Halves	.....Quarters	.....Dimes	.....Nickels	.....Pennies
4.	" 7 " " " 89 "	.....Halves	.....Quarters	.....Dimes	.....Nickels	.....Pennies
5.	" 6 " " " 48 "	.....Halves	.....Quarters	.....Dimes	.....Nickels	.....Pennies
6.	" 4 " " " 36 "	.....Halves	.....Quarters	.....Dimes	.....Nickels	.....Pennies
7.	" 6 " " " 90 "	.....Halves	.....Quarters	.....Dimes	.....Nickels	.....Pennies
8.	" 7 " " " 71 "	.....Halves	.....Quarters	.....Dimes	.....Nickels	.....Pennies
9.	" 4 " " " 55 "	.....Halves	.....Quarters	.....Dimes	.....Nickels	.....Pennies
10.	" 5 " " " 32 "	.....Halves	.....Quarters	.....Dimes	.....Nickels	.....Pennies
11.	" 7 " " " 48 "	.....Halves	.....Quarters	.....Dimes	.....Nickels	.....Pennies
12.	" 3 " " " 16 "	.....Halves	.....Quarters	.....Dimes	.....Nickels	.....Pennies
13.	" 6 " " " 55 "	.....Halves	.....Quarters	.....Dimes	.....Nickels	.....Pennies
14.	" 7 " " " 57 "	.....Halves	.....Quarters	.....Dimes	.....Nickels	.....Pennies
15.	" 6 " " " 73 "	.....Halves	.....Quarters	.....Dimes	.....Nickels	.....Pennies

If you have a "head for finance," you probably will be able to complete this test quickly. Write down the answers in the proper blank spaces and work until you have finished. Do not look for your rating on page 133 until you have completed all tests



This test, by which you can estimate your sense of form and your mechanical skill, is like the familiar jigsaw puzzle. In each lettered section indicate with a pencil in the large figure at the right the

outlines of the small figures at the left. In each case the small figures, properly redrawn, will fit exactly into the large figure. Work for five minutes. Then turn to page 133 to discover your rating

One Man Submarine Dives 500 Feet

A DIVING suit weighing half a ton and equipped with electric lights and a telephone was used recently for the first time in the open sea in efforts to salvage the British submarine, *M-1*, sunk in 240 feet of water in the English Channel. German inventors volunteered the use of the apparatus which, tests showed, could be used in 500-foot depths.

The strange new suit, shown in detail below, is built of aluminum alloy and resembles somewhat a submarine in its interior mechanism. Arms and legs are given flexibility by ball and socket joints. Tanks, filled with water, give the diver the weight to sink into the sea at 250 feet a minute.

No surface air is needed, the suit carrying oxygen enough to last three hours. A mask over the mouth absorbs exhaled carbonic acid. Air pressure equal to that at a depth of 30 feet is maintained constantly. Without the necessity of adjusting the body to changing pressures, a diver in the apparatus can reach in two minutes three times the depth reached by a diver in an ordinary rubber suit in 45 minutes.

Communication is maintained by means of a steel hoisting cable carrying three independent telephone wires. When this cable is fouled, the diver can detach it and reach the surface by "blowing" the water from his ballast tanks with compressed air, thus lightening his weight.



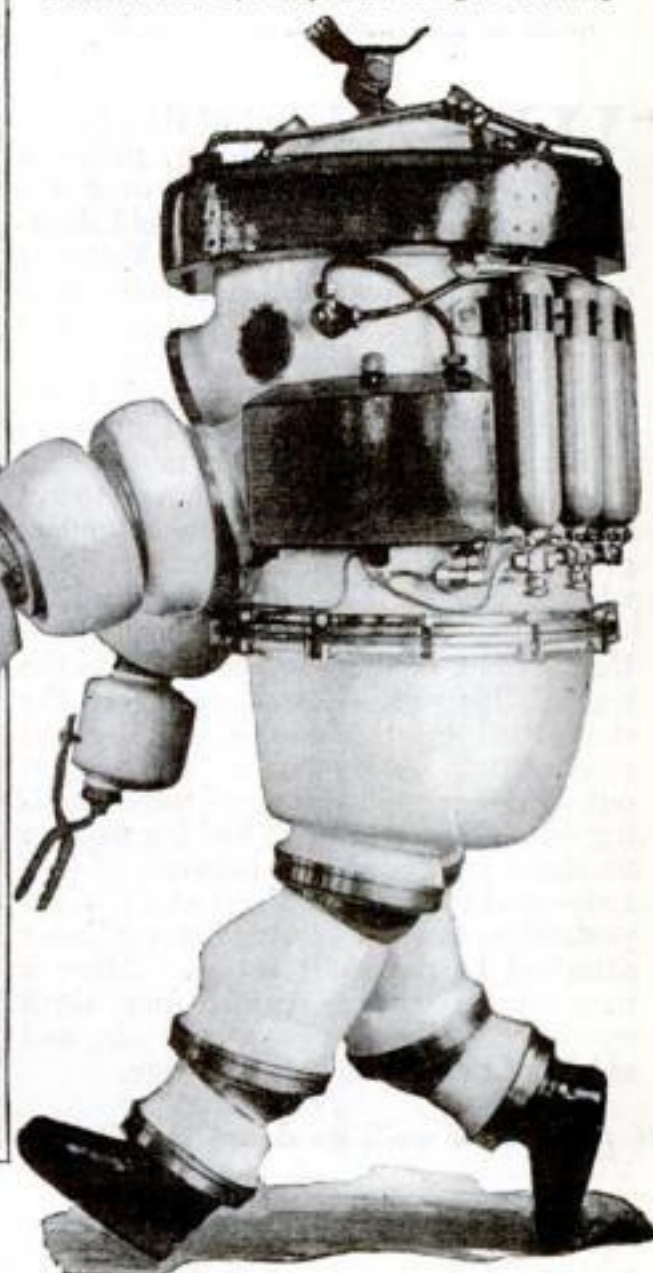
Germans Help Salvage British Ship

A German diver clad in the amazing new mechanism being hoisted from the bottom of the sea after efforts to salvage the British submarine *M-1*, a ship built to fight Germany



Electric Lights and Telephones at Sea's Bottom

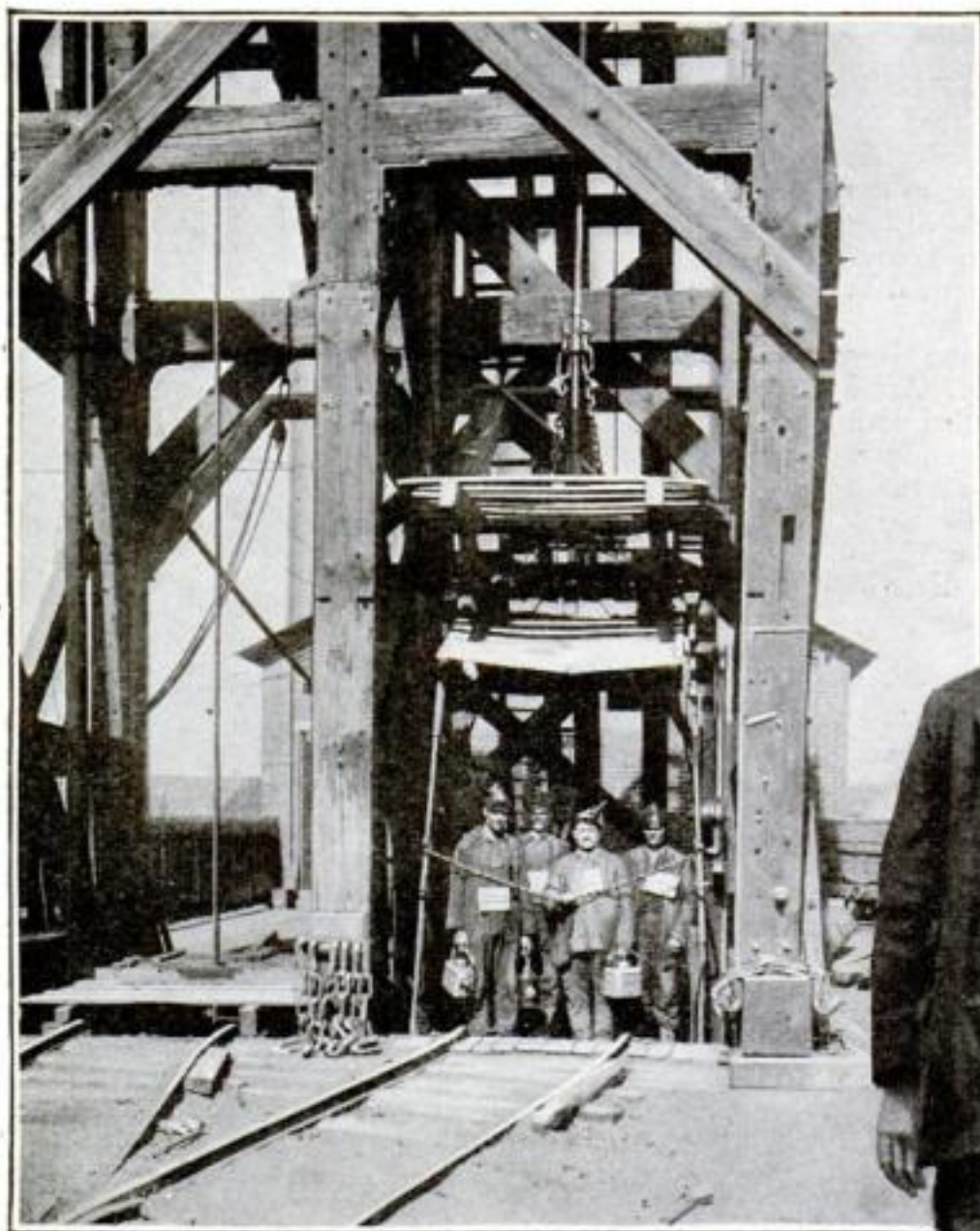
An unusual drawing, showing the interior controls and registering instruments of the strange apparatus, built after seven attempts by Neufeldt and Kuhnke of Kiel, Germany. Resemblance between the suit and an exaggerated outfit of medieval armor is seen in the photograph on the right



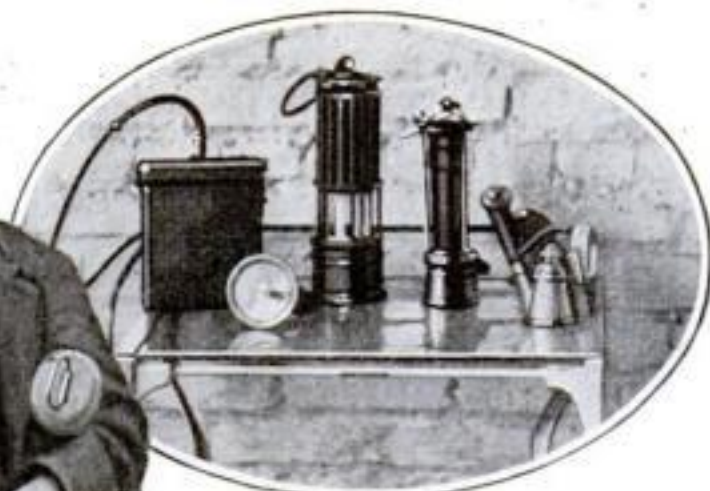
He Wouldn't Trade Jobs with

*Fifty Years a Coal Miner,
David Jones Finds a New
Thrill in His Work Every
Day—His Narrow Escapes*

By ARTHUR GRAHAME



The shaft head, showing miners about to descend into the vast underground structure as deep as the Woolworth Building is tall



Four Types of Miners' Lamps

Left to right: Most modern electric lamp with extra emergency light; improved type of lamp burning fish oil; old type lamp without a glass window; the often dangerous open flame lamp

"WE'LL soon be out of this, then," said old David Jones, rolling a disparaging gray eye over the drab murk of storm cloud and cold slanting rain that filled the Wyoming Valley of eastern Pennsylvania's anthracite coal region. "Underground it's always fair weather, cool enough in summer and warm enough in winter for a man to do his work in comfort. It's fifty long years and more that I've been a miner, and what has put the aches and pains into my old bones is not the hardships underground, but the cold and wet overhead when I come up the shaft to go off shift."

I had asked old David to show me through one of the deepest mines in the region (this was a few days before the strike tied up the mines), and he had consented to be my guide. He stepped out of the cage in which we were standing—an innocent enough looking wooden platform suspended by a network of iron rods—and tugged four times at a plunger protruding from a foot-long brass cylinder attached to the shaft frame. After a moment an answer came, four shrill squeals of released compressed air, and old David came back to the cage.

"AND now we'll go down, then," said David. "Keep your hands in and—"

The innocent looking platform sank with us jerkily and swiftly. In one swift

The Veteran

In fifty years of coal mining, David Jones has been trapped at least six times; yet he says "a man's safer underground today"

instant the light of the dull day was changed to murky twilight; in the next instant darkness leaped on us from every side, darkness that extinguished everything but the clatter of the cage over its guides and the sound of old David's deliberate voice in my ear.

"Black as the pit from pole to pole," he was quoting, for old David knows his Henley, and can deliver whole passages of Shakespeare in a manner that won him the praise of Mr. Walter Hampden when that distinguished tragedian ventured underground.

There was a pause that seemed long to me. The cage clattered downward.

"Yes," old David began again, casting back to our conversation at the shaft head, "for fifty years and more I've been a miner, and in the old country my father was a miner before me. Killed he was, then, when the pumping engine beam broke at Hartley colliery back in '62, and fell into the shaft and blocked it so that every man at work in the levels was

starved to death before it could be cleared."

Another pause. A cheering anecdote! Now it seemed that the downward motion of the cage had been arrested; that we were hanging motionless in an immensity of blackness.

"We've stopped," I ventured.

"No," answered old David, "we're close to the bottom of the shaft now, and it's the air pressure against the bottom of the cage that makes a cushion for us to ride on. You'll take hold of my arm if you're dizzy, and yawn till your jaws crack if your ears are ringing.

"It's a little uncomfortable the first time you come down," he went on—understating the fact—after I had followed both his suggestions, "but a man's safer underground than he is on top nowadays, what with the flivvers and one thing or another. Accidents like the one that cost my father his life can happen no more, for now, unless you are caught by a rock fall in a heading, there's always another way out. You can walk to daylight from any spot in this mine within a couple of hours—if you know the way. Although the levels are deep underground, they follow the contour of the valley, and each one has its outcrop on a hillside. So it would be a very unusual accident that could trap one of our men."

SUDDENLY, the cage came to a gentle stop at the foot of the shaft, where a single electric bulb burned over the white-washed entrance of a cavern that soon lost itself in black subterranean shadows.

"We're here, then," said David, grinning. "In the Red Ash vein, seven hundred and twenty feet below the surface.

the President!

No rain, you see, and just cool enough to be comfortable."

Men who were waiting to run coal-laden mine cars onto the cage platform exchanged jocular greetings with old David.

"Everything a coal mine needs and everything it gives comes down or goes up the shafts," said David. "Men and tools and powder and mine timbers come down; and the coal goes up, and the boys when their eight-hour shift is done.

"Well do I remember the first day I came to work in the mines," he went on, leading the way into the shadows of the cavern. "I was but a green lad then, fresh in America from old Wales, but I got through a long shift well enough by doing just what the grumpy old miner I was mucking for bade me do, so when knocking-off time came at last I was feeling pretty cocky as I followed him along the main mine road toward the shaft to be hoisted to the surface. Then, after we had gone a ways, I remembered that I had left my coat in the heading where we had been working. By that time the boss had got into an argument with another miner, and I didn't dare interrupt to ask him to go back with me.

"WELL, I didn't want to go home without my coat, so without saying a word to anybody I went back after it. I knew the way well enough, I thought, and I had an oil lamp burning in my cap. I'd get my coat and catch up with the boss before he got into the cage.

"So back I went, counting the turns, and I found the coat easily enough. But it was creepy and dismal there alone in the dark, and I was in a tearing hurry to get back to the other men. So when I came to the first turning and saw the flare of a miner's lamp a couple of hundred feet down the level, I followed it, hoping for a short cut. Then the light disappeared as suddenly as if it had been blown out. The man wearing it must have turned into a cross-heading. But when I came to a passage leading from the

Testing for Fire Damp

Below: How the safety man takes samples of air in the workings to test it for fire damp, the dangerous carbon-monoxide gas that can cause terrific explosions. Each morning before the miners go down the shaft, headings in which they are to work are tested



one I was in I could see no glimmer of light. I shouted, but I got no answer.

"Well lost I was by then, and as I stood there in a stillness broken only by the drip of water somewhere near, trying to think what I should do, my lamp began to flicker. Then it went out."

Old David Jones placed a careful hand on my arm to guide me around a wet spot in the dimly seen roadway. Then we turned into a cross passage, and ahead of



Electricity Replaces Picks

Fitted with a series of sharp picks moving on an endless chain, this modern electric cutting machine bites its way into veins of coal, performing the work of a gang of men. It travels on rails under its own motor power

us shone bright lights, and men's voices sounded, and the whir of machinery.

"That's the pump room ahead," said David. "Night and day the pumps work, because for every pound of coal that you win from a mine you must pump out twenty-five pounds of water."

"But," I demanded, "how did you get out when you were lost?"

"OH, THAT," said David casually. "Well, then, I was a fool. I should have sat down where I was and waited for someone to find me. In those days they didn't have the system for keeping tabs on the men that they have now—when the level boss must stay by the shaft gate until every man has hung his working check on the board, to make sure that no poor devil has been caught by a rock fall at the last minute—but my boss would have missed me in the morning and started a search. But I was scared out of my wits by the darkness and the stillness, so I staggered on and on, shouting, and butting my silly head against hard rock walls, and falling down and getting up again, until all my strength was gone. By that time I had wandered into a worked-out section of the mine. There they found me thirty-six hours after I had lost myself, too weak to move, and all the way out of my head from the dark loneliness."

WE PASSED the entrance of a lofty rock chamber where gigantic pumps worked with smooth power, electric lights gleamed, and engineers armed with long-spouted oilcans worked placidly, apparently with never a thought for the millions of tons of rock and coal hanging over their heads. Then we stopped, and

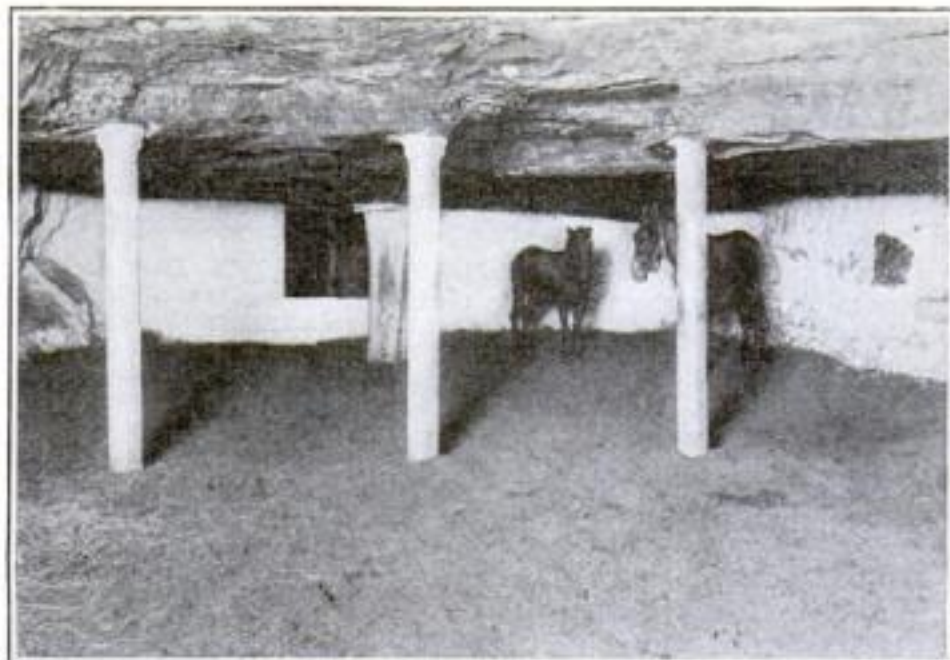


How coal is sorted. Coming from the mine, it pours down chutes onto these graded screens, each of which allows lumps of a certain size to pass through the different screens and then to the bins



"Electric Mules" Now Haul Mine Cars

Electric locomotives such as this are rapidly replacing mules for hauling the mine cars. In workings where gas is particularly bad and where sparks might be dangerous, compressed-air locomotives are being used.



An Underground Pasture, 720 Feet Down

A pasture for mine mules 720 feet underground. The floor is of clay. The area of the pasture is 100 by 50 feet, and it is designed to accommodate 10 mules at a time. Modern machinery is now taking their place.

David opened an iron door in a rock wall.

"This is the level boss's office," he said, as we entered a 20-foot-square room, its rock walls whitewashed and bare.

"**N**OW, then," he went on, perching himself on a stool, "the Big Boss told me to show you the mine. It's your imagination you'll have to use to see it all, then. Think, then, of an office building as tall as the Woolworth Building that I saw in New York, and covering many square miles where the Woolworth covers but a single block, and built down from the surface of the earth instead of up from it; with shafts taking the places of elevators, levels instead of floors, mine roads in place of main corridors, and working headings in the coal in place of cross corridors. If you can imagine that, you'll have a rough outline of the layout of a coal mine.

"But there's this difference—a coal mine has far fewer levels than a tall building has floors. At this minute we're pretty nearly as deep underground as the Woolworth Building is high, but in this mine there are but seven levels—the Red Ash that we're in, that follows a coal vein eighteen feet deep, and six others that follow veins from four feet to eight feet deep lying between us and the surface. Between each of these veins is sixty feet or so of sandstone or shale. You didn't notice the entrances to the other levels when we came down, for they are served by other shafts.

"**T**WO things you must do before you can win coal from a mine—you must pump water out of it and fresh air into it. It's not from underground streams nor straight down from the surface that most of the water comes. The driest part of this mine is right under the bed of the Susquehanna River. The water seeps in through the coal veins from their outcrops on the hill-sides.

"Getting fresh air into a mine is even more important than get-

ting the water out. Maybe when you saw the ventilating fans at work in the engine house by the shaft head, you made the natural mistake of thinking they were pumping fresh air into the mine. Well, then, that's what they really do, but they do it by drawing the stale air and gases up through the upcast pipe, and the fresh air rushes into the mine through the intake pipe.

"Fresh air every minute is a life-and-death matter to the men working underground, and the mine roads and headings are laid out so that there always will be a good brisk current going through them; and on the surface there is an extra fan and engine always ready to be switched on in case of a breakdown. When, in the course of mining, passages are cut that would cause the air to short circuit, and so leave parts of the mine without a fresh supply, we put in airtight doors that

close themselves and so are foolproof.

"And now that you've got some idea of the layout of a mine," concluded old David, "we'll go out into a heading and you can see for yourself how the coal is taken from the workings."

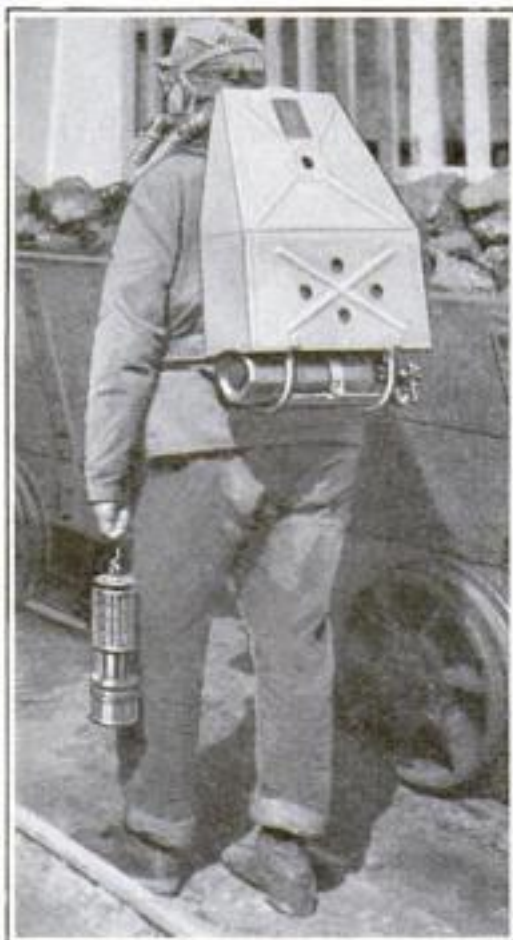
FROM a shelf he took an electric lamp, fixed it in his cap, and slung the battery around his neck. "It's as a hazardous occupation that they classify coal mining," he said, "and in that they're right enough. But it's not nearly so hazardous as it was in the old days. Why, as late as 1908 there was a miner killed for every 167,407 tons of coal that was sent to the surface, while in 1922 there were 233,576 tons of coal mined for every life that was lost underground." David grinned at me. "You wonder, then, at me quoting statistics to you? It's a safety man's job that I hold down nowadays, and I load up with arguments to make the boys careful.

"What do safety men do? Every morning, before the boys come down the shaft, we come into the levels and test every heading in which men are going to work—for fire damp and for loose rock in the ceilings. Every miner must report here at the level boss's office to get his working check, and if there is a dangerous condition reported in his heading, he isn't allowed to go to work until all has been made safe. Fire damp is driven out with fresh air, and a loose ceiling properly timbered."

"**F**IRE damp is the coal miner's most dangerous enemy, isn't it?" I asked.

"Well, then," said David politely, "it's natural that you should think so. When a gas explosion in a mine gets into the papers, it's because it has killed several men. But as a matter of fact, rock falls from the roofs of the levels kill eight miners to every one that is killed by gas. But rock falls usually kill only one or two men at a

(Continued on page 134)



The Rescuers

Two types of improved gas masks worn by mine rescue crews. These men hold drills once a week and stand ready for quick action in case of fire explosion, or cave-ins.



From a Weakling to a Hercules

How Puny Boy Became the World's Strongest Man

As Told to Arthur A. Stuart

By FLORENZ ZIEGFELD, JR.

Everybody knows of the famous producer of the Ziegfeld Follies. But everybody does not know that it was Ziegfeld who engineered Eugene Sandow's sensational conquest in America in the early '90's. Here, from his own personal experience, he tells the fascinating story of the world's strongest man

A DELICATE, curly-haired lad of 10 stood with his father before the marble statues of ancient gods and heroes in Rome. Wide-eyed, he marveled at the sculptured ideals of manly power and physical perfection. He compared his own pitifully frail body—the frame of a weakling—with the bulging muscles and beautiful symmetry of the heroic figures before him. And in his heart he made a silent vow that some day he would be like them—one of the strong and mighty.

That was nearly 50 years ago. Just the other day there died in England the amazing fulfillment of that ambition—Eugene Sandow, a man admired and honored by the world as the greatest strong man of modern times.

Within a comparatively short lifetime—marked by an intense devotion to a boyhood ideal—he had refashioned the weakling body into a marvelous human power machine of whipcord muscles and sinews of steel—the idol of millions in his prime; honored by kings, princes, and presidents; patronized by aristocracy and adored by gentlewomen; worshiped by strength-loving youth everywhere.

By sheer determination Sandow made himself a Hercules. I have seen him cow a circus lion, gripping the king of beasts by the throat with his bare hands. I have seen him bend backward and lift a horse over his head. I have seen his powerful fingers tear a double deck of cards in two like so much tissue. With the aid of harness he could lift a weight of three tons. On the palm of one hand he could lift a man to the top of a table. In the bearlike grip

of his bulging arms he once crushed the ribs of a giant opponent who sought to vanquish him by foul means. His mighty chest could support the load of three horses. And once, I remember, he supported 32 members of our company and myself on his back very easily.

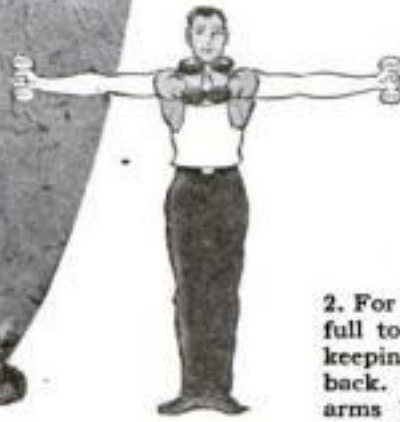
In recent years there have come successors who possibly have surpassed him in muscular power. Sigmund Breitbart, for example, the astonishing giant who could bite a heavy chain apart with his teeth and who, strangely enough, died within a few days of Sandow, might have outdone him in physical prowess. Yet the name of Sandow was, and still is, synonymous with that of Samson. To be a "perfect Sandow" is to possess superlative strength and unusual muscular development. The reason for this—the reason why Sandow will be remembered as the mightiest long after others are forgotten—lies not so much in the tremendous feats he performed as in the fact that he showed men and women, the robust and weaklings alike, how they, too, could become strong as he was.

Often have I heard Sandow say to his admirers: "You, or any other average man, can become not only an athlete, but you can acquire strength equal to my own if you will pursue the same rigid discipline I have pursued."

To prove that what he said was so, he offered himself as an exhibit, and he gave to the world the first really scientific system of physical culture, based on the very methods he had used to build his own body. In this he was a

(Continued on page 137)

Eugene Sandow



1. For the sides: Bend the body sideways from each hip, as shown at right, without moving the lower limbs. Alternately bring right and left forearm under the upper arm, with wrist rolled beneath armpit

2. For shoulders and chest: Bring arms full to front in line with the mouth, keeping elbows straight and head well back. From this position throw both arms back in line with shoulders, returning them quickly to front again

Sandow's Eight Ways to Grow Strong



3. For biceps: Turn inner sides of arms to the front, and alternately bend each arm at elbow, bringing dumb-bell close to shoulder

4. For biceps and triceps: With arms in line with shoulders, alternately bend arms up and inward until dumb-bell is over shoulder

5. For chest, back, arms and abdomen: Support body on arms and toes, alternately raise and lower body by respectively straightening and bending arms. 6. For abdomen: Lie flat on back, raise both legs simultaneously with knees quite stiff

7. For shoulders: Bend both forearms upward from elbow; alternately extend each arm over head; bring the elbow back close to side

8. For forearms and wrists: With arms extended horizontally, turn hands quickly on axes of wrists, front to back, then back to front

They Laughed at Him, but He Gave Us the Telephone

The Story of a Young Inventor Who Wouldn't Stay Discouraged

By EDGAR C. WHEELER

THERE is a favorite story about the young Alexander Graham Bell. Just 50 years ago, Bell's first crude baby telephone had been placed on exhibition in an out-of-the-way corner of the Centennial Exposition in Philadelphia, while its struggling young creator remained in Boston, "broke." Every penny had gone into his invention, and he felt he could not afford to make the trip to the exposition.

But Bell had fallen deeply in love with a little deaf girl, Mabel Hubbard. She was making the trip to the exposition and the young inventor went to the railway station in Boston to say good-bye to her. There she learned for the first time that he was not to go; was not to see the product of his labor gain a place in the halls of fame. She coaxed him to go. He remained firm. She pleaded, to no avail.

At last, just as the train was pulling from the station, Bell saw the girl in tears! Of course, he did what any other ardent lover would do. He dashed madly after the train, and leaped aboard—without baggage or ticket. And so he went to the Centennial, and there, by the merest thread of a chance, he got his opportunity to give to the world what is perhaps the most tremendously useful of all today's marvelous agencies of civilization.

One reason why this little story is repeated here is this:

The other day I mentioned it to an old employee of Doctor Bell. And he told me the story couldn't be true, couldn't have happened.

For my part, I'm just as well satisfied, and the story of the impetuous lover is just as real as it ever was. For all the rest of the wonderful things this inventor did couldn't have been true, either. The most learned scientists and experimenters of the day said so.

THE telephone, they asserted, never could happen. Make a wire talk? Absurd! A hole through the center of the wire, perhaps. A hoax! A wild dream of a visionary boy!

And yet—we have the telephone today. Even now, as you put a funny looking black thing to your ear and hear the voice of a friend from hundreds or thousands of miles away, it seems scarcely possible that it can be true. And yet it is. Or, as majestic organ notes come floating out



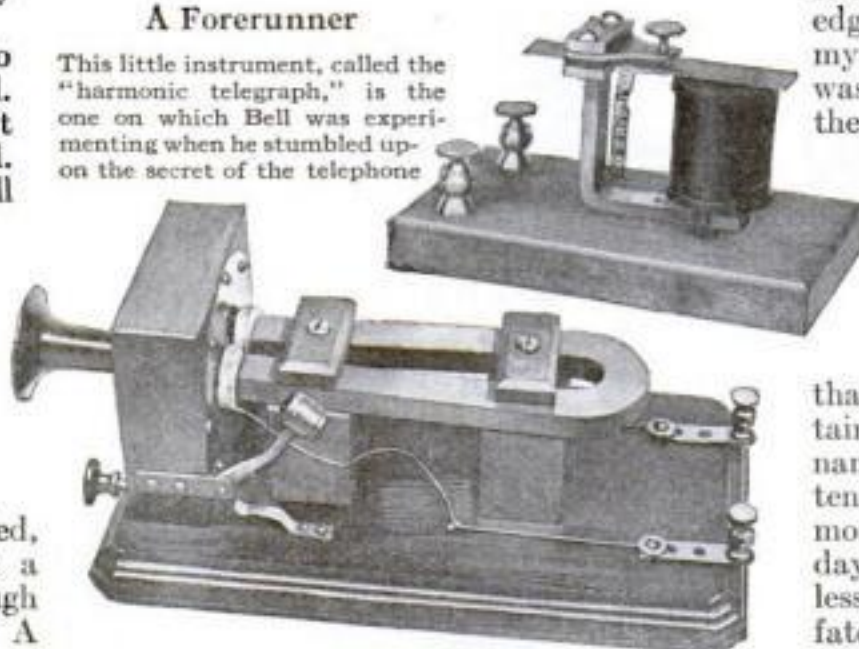
Dr. Alexander Graham Bell, inventor of the telephone, opening the first New York-Chicago long-distance line, October 18, 1892

into your room from the radio loud-speaker—music brought across a continent through 3000 miles of inarticulate nothingness—you feel that it really can't happen. And yet, marvelously, as we all know, it does!

That these things are so—that we can talk by wire and talk by wireless, and can

A Forerunner

This little instrument, called the "harmonic telegraph," is the one on which Bell was experimenting when he stumbled upon the secret of the telephone



The First Commercial Telephone

It seems crude now, but half a century ago it was the marvel of the world. This instrument served both as transmitter and receiver. When one party wished to call another, he pulled the little knob at the base. This simple means caused a small hammer to strike against the diaphragm, producing a loud knocking in a similar instrument at the other end of the line

be heard as clearly as if we were talking to some one in the same room—is due solely to the fact that a tall, pale-faced professor in his twenties, whose profession was to teach deaf mutes how to speak, didn't know it was impossible to transmit to a distance the sound of human voices by electricity and refused to believe it impossible.

WHEN older and supposedly wiser heads ridiculed him and called him a dreamer, he went to work all the harder, in blissful disregard of their reasons why "it couldn't be done."

"If I can make a deaf mute talk, I can make iron talk," he once said to his patron, Gardiner G. Hubbard.

Hubbard laughed at him. "You're talking nonsense," he said.

But Bell stuck to his vision. And with the fine courage and tremendous enthusiasm of youth, he made his dream, and more, come true.

Fate, too, which somehow appears ever to watch over the discouraging struggles of young inventors, took a hand.

Thus, if Bell had not been a voice teacher, and if he had not met and fallen in love with a deaf girl, the secret of the telephone might yet remain to be discovered. For, as you will see presently, it was only through his thorough knowledge of the mechanics of sound and the mysteries of speech and hearing that he was able to recognize the first wee voice of the "talking telegraph" when it came to him in a revealing flash.

Again, if a young mechanic who was aiding him in his experiments had not turned down a certain screw too tightly, that first voice never could have been heard.

And, finally, if Bell hadn't caught that train for Philadelphia, and if a certain Emperor of Brazil, Dom Pedro by name, had not happened along at the Centennial Exposition at the most opportune moment, the embryo telephone might today be resting in some museum as a useless and curious scientific toy. Such a fate is not at all hard to imagine.

THE Sesqui-Centennial Exposition that is scheduled to open in Philadelphia in June, commemorating the one hundred and fiftieth anniversary of the American republic, will commemorate also the dramatic scene that took place in that other exposition 50 years ago, when Bell's

telephone was brought to the attention of the scientific world as something workable.

It was a hot Sunday in June. For six weeks the models of Bell's first receiver and transmitter had been lying almost unnoticed on a little table shoved in a corner between a wall and a stairway. But on this day the exposition judges had promised to spend a few moments, during their tour of inspection, examining the odd creations.

THE young professor stood by his little table waiting, nervous and a little discouraged, perhaps, as hour after hour of the hot afternoon went by without a sign of the judges. When at last they came, the day was spent. They were tired and hungry and uninterested. One of the judges picked up the telephone receiver, glanced at it, and placed it back again on the table. Another made a derisive remark, and the rest laughed. Bell's heart sank. But just then there happened an amazing thing. Into the room walked Dom Pedro, the Emperor, followed by his retinue. With arms outstretched he strode straight to the young inventor.

"Professor Bell," he exclaimed, "I am delighted to see you!"

If the judges were surprised, Bell was dumbfounded. He had forgotten that Dom Pedro once had visited his school for deaf mutes in Boston and that the emperor had been interested in establishing a similar school in Brazil.

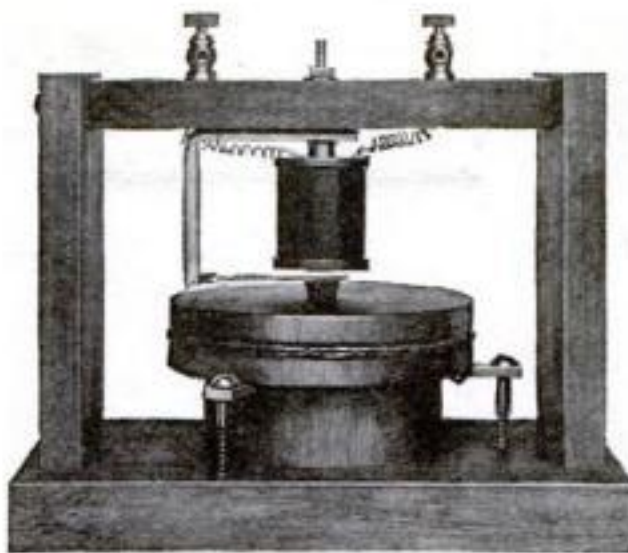
Of a sudden the judges became all attention as Dom Pedro placed the receiver to his ear. Bell, who had strung a wire across the room for demonstration purposes, stepped to the far end and spoke into the transmitter. As he did so, Dom Pedro jerked his head away from the receiver, threw up his hands in utter amazement, and cried:

"My God, it talks!"

IT CERTAINLY did. Every one of the judges wanted to try it. What a moment before had been ridiculed as a "play-thing" instantly became "the most marvelous discovery in electrical science." That dramatic moment marked the beginning of the telephone's growth, a growth so tremendous that today, half a century later, more than 16,000,000 telephones are serving the people of the United States alone, and telephone service has become one of the most commonplace necessities of our every-day business and social life.

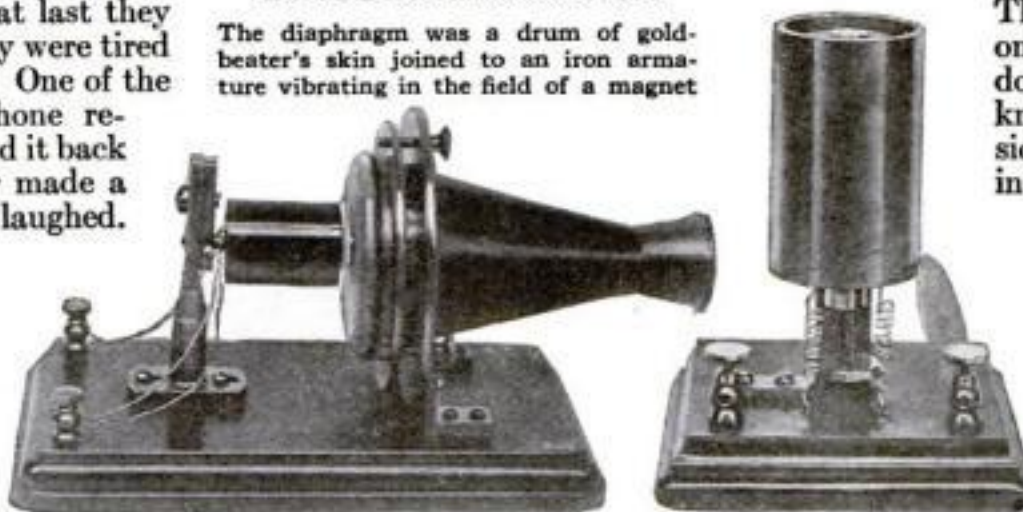
Luck, you may say, was with Bell. Undoubtedly it was. But it was the kind of luck that, by some strange quirk of creation, comes unexpectedly to reward the man of vision who clings desperately to an elusive idea and spends days and nights of heartbreaking labor overcoming failures and carrying his idea to fulfillment.

Perhaps the most remarkable thing about Bell's invention was the fact that he was not an electrician. His knowledge of electricity was exceedingly limited. On the other hand, he was a specialist in vocal physiology, as his father and grand-



Bell's First Model of 1875

The diaphragm was a drum of gold-beater's skin joined to an iron armature vibrating in the field of a magnet



The Instruments that First Learned to Talk

At left is the first transmitter and at right the first receiver that sent and received spoken messages intelligently. These are the humble instruments Prof. Bell exhibited at the Philadelphia Centennial Exposition in 1876



How They Used to Do It

Here is a 1926-model girl talking over an 1878-model telephone. One of the two wooden hand phones was the transmitter, the other the receiver. The hand switch at the bottom of the board switched the bell circuit on and off. It was impossible for the user to hang up the instruments without throwing the switch

father had been before him; a student of voice, of tone, pitch, and modulation. To him the sound box of the voice and vibrating diaphragm of the ear suggested untold possibilities for creating a mechanical sound box and a mechanical diaphragm that might transmit the vibrations of sound, with all its intricate variations, through the medium of electricity.

"If I could make a current of electricity vary in intensity precisely as the air varies in density during the production of a sound," he confided to Thomas A. Watson, the young mechanic who was his able right hand man in his historic preliminary experiments, "I should be

able to transmit speech telegraphically." And so he sought to apply his knowledge of sound to the mysteries of electricity through tireless plodding experiment. In this, strange to say, his first important asset was his very ignorance of electrical science.

"HAD I known more about electricity and less about sound," he once said, "I never should have invented the telephone."

The explanation was this: Electrical experts of the day, to whom the telegraph and the Atlantic cable were the crowning achievements, already were bound by rules and formulas. They had set certain limitations on electricity and what it could do. They knew, or thought they knew, for example, that transmission was impossible except by intermittent current; that is, by making and breaking an electrical circuit as in the telegraph.

But to young Bell, in his ignorance and enthusiasm, nothing was impossible. If his imagination told him it would be a wonderful thing if a continuous current might be made to vary in accordance with variations of sound, why then it might be done regardless of any rules; and it was worth trying.

A second asset was Bell's inherited passion for invention. As a boy he had built an artificial skull of rubber which, when filled with air from a hand bellows, would produce a sound startlingly similar to the human voice. He also had devised a toy dog that would bark. When at the age of 24 he was called to Boston to teach a school of deaf mutes, and later when he became a professor of elocution in Boston University, his enthusiasm for invention persisted.

THE cellar in the home of one of his deaf pupils became his laboratory and workshop, and there in a litter of wires, tuning forks, and magnets he spent every spare hour. One of the first products of his experiments was a machine for making visible records of sound vibrations, with which he hoped to aid the deaf to speak. Once, when he mentioned his experiments to a Boston surgeon and aurist, the latter suggested:

"Bell, why don't you use a real human ear?"

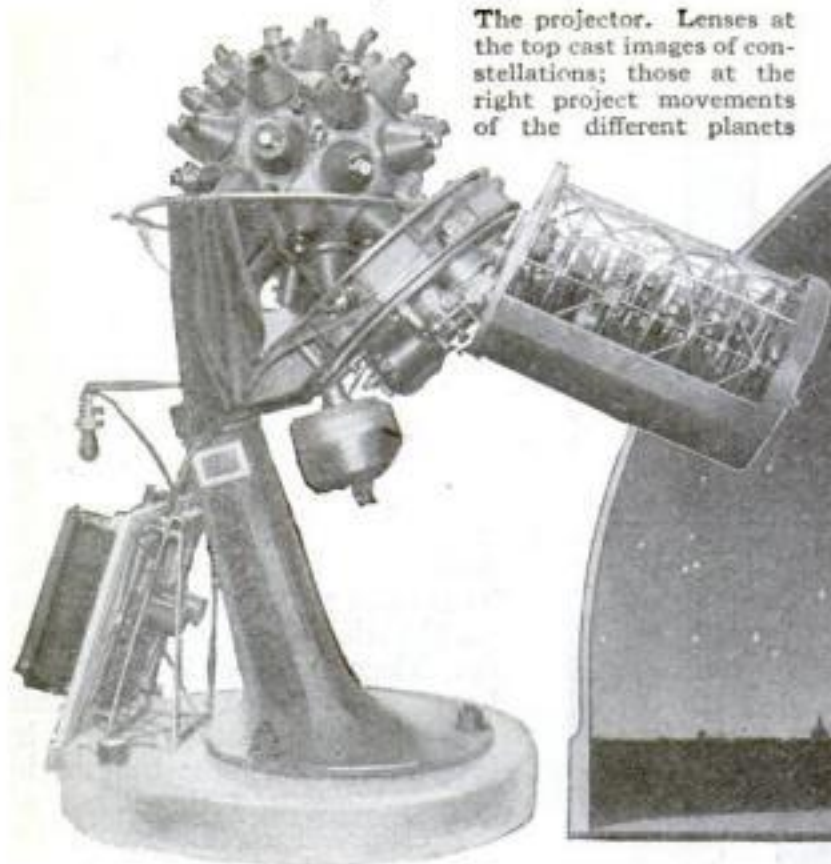
The surgeon supplied the ear, and Bell proceeded to rig up a contrivance by which, when he spoke or sang into the ear, a straw attached to the eardrum would make a visible record of the vibrations on a moving piece of smoked glass.

In his study of the ear, Bell was amazed at the efficiency with which the delicate eardrum could transmit vibrations through heavy bones. "If this thin little disk can set up vibrations in bones," he asked himself, "why can't a metal disk set up vibrations in a metal wire?"

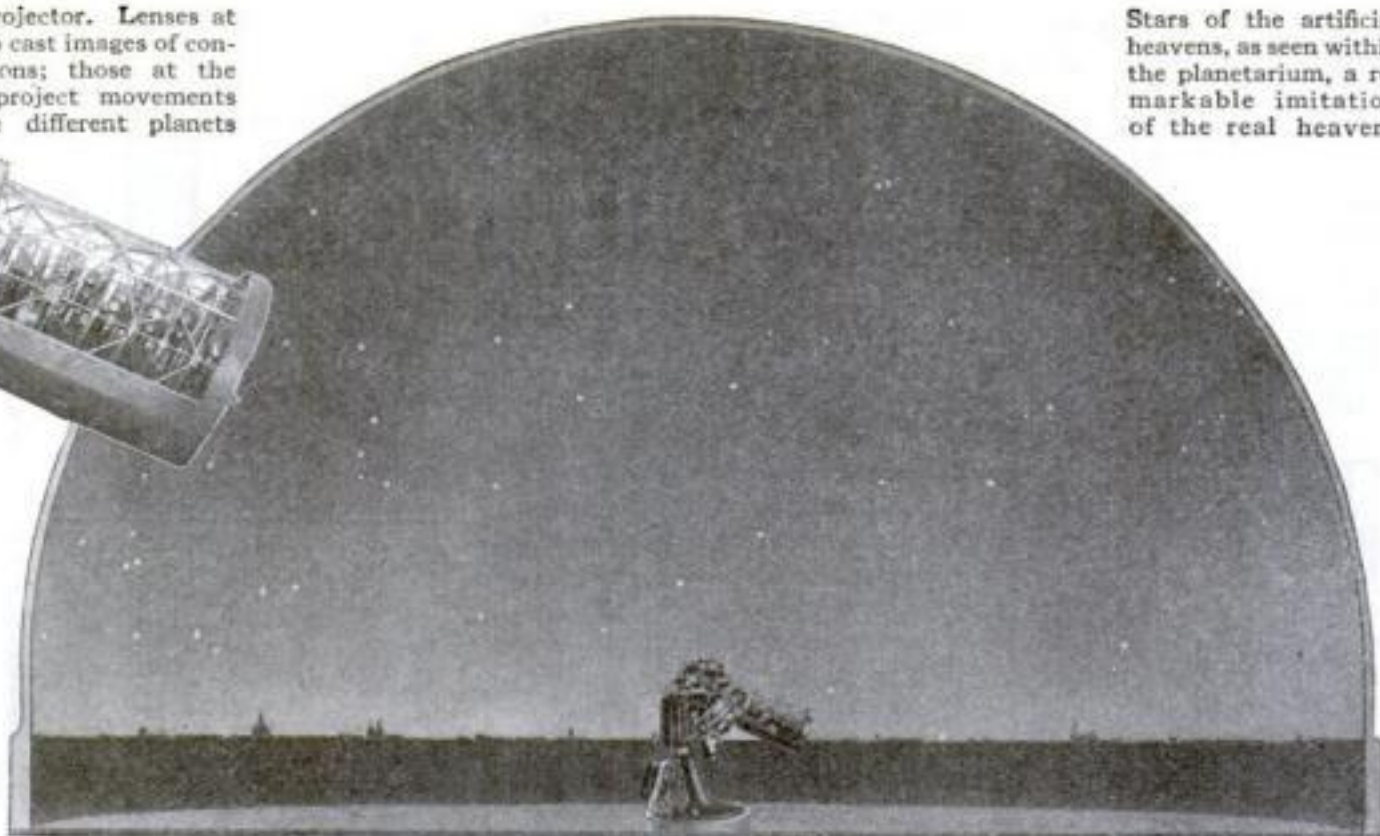
Out of this query grew the conception of telephone diaphragms connected by an electric wire.

Another product of Bell's cellar laboratory was an instrument that he called

(Continued on page 149)



The projector. Lenses at the top cast images of constellations; those at the right project movements of the different planets



Stars of the artificial heavens, as seen within the planetarium, a remarkable imitation of the real heavens

Stars Move across Concrete Heavens

A Remarkable New Way to Teach Wonders of Astronomy

By NEWTON BURKE

YOU enter a large dome-shaped concrete building. It is dark. Suddenly, thousands of glittering stars appear in what seems to be the infinite sky. More marvelous, suns and planets begin their majestic march across the heavens. In a few moments intricate celestial motions are revealed so simply that you, who perhaps have never opened an astronomy book, can understand mysteries of the universe that puzzled scientists for centuries.

Such a graphic picture lesson in astronomy has been made possible by a remarkable invention called the "planetarium," which recently has attracted wide interest in Germany and which soon may be available to the American public in a number of our large cities, including Philadelphia, New York, and Rochester, N. Y. The intricate movements of the stars, the sun, moon, and planets as seen from the earth are said to be duplicated with amazing accuracy.

The ingenious idea of this planetarium, worked out by the Carl Zeiss Optical Works at Jena, is one never tried before. Many instruments have been built to represent the motions of heavenly bodies, in which the planets were attached to radial rods, but the spectator had to observe all their workings from the outside, and the movements were not like what we see from the earth. In the new planetarium the observer is inside, located on the earth, so that he sees actually what is observed every night, only with the speed greatly quickened.

A huge hemispherical dome is used as a projec-

tion screen upon which a system of optical projection lanterns located in the center of the dome throws images of the stars and planets. Four thousand five hundred fixed stars of the first to sixth magnitude—as many as are visible to the eye out of doors—are shown on the dome. These are projected from a part of the machine that resembles a chestnut bur, the end of each "spike" containing a group of lenses. The relative brightness of stars, as we see them, is indicated by using disks of varying diameters according to the stars' magnitude.

A number of special lantern attachments illuminated by a 200-candlepower lamp throw nebulous images on the dome, representing with startlingly realistic effect the misty beauty of the Milky Way.

How to show the movements of the planets was the most complicated problem. These wander in elliptical orbits around the sun, each at a different speed. From the earth they appear to have the most erratic courses. These are projected by a portion of the machine that looks like a big glass cylinder, which contains a series of rotating disks, each revolving in a motion corresponding to that of the body it represents.

The sun, moon, Mercury, Venus, Mars, Jupiter and Saturn are represented. Uranus and Neptune are left out, for these two planets we never see with the naked eye.

Two kinds of rotation are provided for. One shows the motion of the heavens in a day, and the other, the yearly motion. By means of gears the daily motion can be represented in $4\frac{1}{2}$ minutes, two minutes, or 50 seconds, while the happenings of a whole year can be shown in $4\frac{1}{2}$ minutes, 50 or seven seconds.

The instrument can be set to show the aspect of the heavens at any date. You can see how the sky looked when Columbus discovered America, or you can look ahead and see how it will be thousands of years in the future when the earth will have a new North Pole star.

The Jena planetarium has a diameter of 83 feet and has seating accommodations for 700 spectators. It was shaped of fine steel wires and concrete was blown on it until the spaces were filled. The interior, having no seams nor ridges, makes possible the optical illusion that you are actually out in the open looking into vast space.

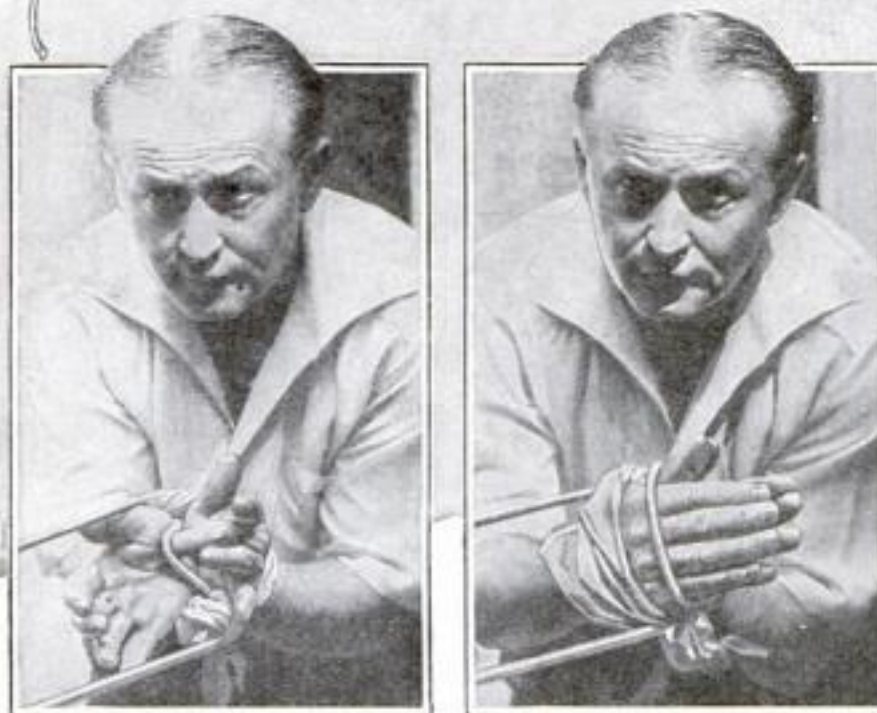


How the Artificial Sky Is Constructed

Cement is blown into a vaulted network of steel, then allowed to set, producing a reinforced concrete dome on which the stars are projected

My Rope Escapes—By Houdini

You Can Mystify Your Friends with These Simple Tricks with Knots



SINCE publication of my series in POPULAR SCIENCE MONTHLY began, I have received many letters from readers who are interested in magic. Almost invariably the writers of these letters have asked me to explain the methods used by certain magicians in performing specific tricks or illusions. Many have requested me to expose the methods that I use in obtaining some of my best known effects.

Let me take the opportunity here of telling my various correspondents that, although I appreciate greatly their interest, I am unable to grant their requests.

To expose the tricks of any reputable magician would be contrary to the ethics of my profession. A magician's secrets are his stock in trade; the tools and materials by which he earns his living. Illusions that require only a few seconds for their performance often are the result of years of patient study, experiment, and practice.

Were a magician to nullify all his study and practice by exposing his own tricks, he would be silly indeed, for his only hope of retaining his power as an entertainer lies in mystifying his public. And for one magician to expose the methods of another magician—provided he knows them—would be merely an inexcusable act of viciousness that could do no possible good.

The tricks of charlatans and swindlers, of course, are a different matter. I always am ready to expose the methods of those who prey upon deluded persons by absurd claims of superhuman powers that they attempt to substantiate by trickery.

As a member and nine-time president of the Society of American Magicians, I am bound to protect legitimate mystifiers. I have told the readers of this magazine in earlier articles how fakers and miracle mongers have "borrowed" the tricks of professional entertainers and used them to delude and defraud. It would do immense harm were I to put into the hands

The Handkerchief Release

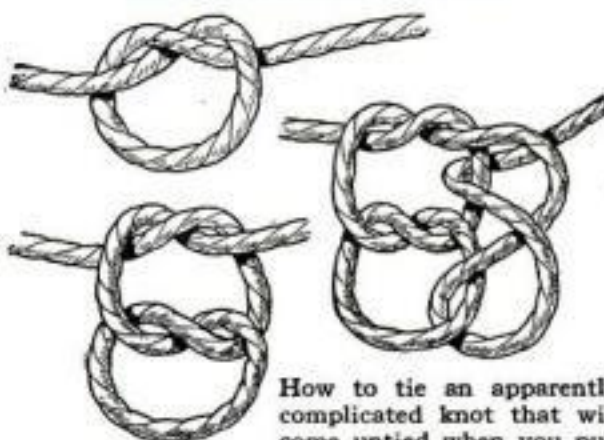
How Houdini does the handkerchief release, a trick in which he frees himself from a rope passed around a handkerchief that binds his wrists together, the ends of the rope being held by one of the audience. The picture to the left shows him working the loop of the rope between his wrists until it can be seized by the fingers and drawn through the handkerchief. At the right he is seen slipping the loop over his fingers. The rope then slips out of the handkerchief as soon as it is drawn tight.

of these swindlers new ways of defrauding the public by exposing my own tricks or those of other reputable magicians.

However, there are tricks—good tricks that are within the capabilities of amateur mystifiers—that I can explain. And I am going to devote the rest of this article to teaching those who have ambitions in that line how to do some "escapes," that is, how to liberate themselves from rope ties, sacks, and similar restraints.

The ties and escapes I am going to describe are all easy to learn and comparatively easy to perform after a little practice. Added to the sleight-of-hand tricks I showed you last month, they

Knots that Are Not



How to tie an apparently complicated knot that will come untied when you pull the rope tight. Start with a single knot (upper left), then a double knot (lower left), and pass one end through the double knot as shown at the right.

will supply a splendid repertory for any amateur performer—a much larger and more effective "bag of tricks," I might mention, than I myself possessed when I first presented myself to a group of my friends in the role of an amateur conjurer.

As with magical tricks, a prime necessity for success in performing escapes is showmanship. You must present your tricks to the best advantage, amusing your audience and diverting its attention with bright patter, retaining at all times your self confidence and an enthusiasm that your audience is bound to find contagious. Likewise, your program should be arranged with some idea of obtaining a climactic effect. That is, you should present simple tricks—or tricks that appear to be simple—at first, making each succeeding one a little more difficult, until you finish your act with the showiest and most effective trick you know.

AUDIENCES invariably find rope ties and escapes interesting, and you are at a distinct advantage with relation to your audience in presenting tricks of this character in that, unlike the apparatus used in the typical sleight-of-hand performance, there is nothing to excite suspicion in an ordinary piece of rope, tape, or string. The best rope for most escapes is Silver Lake sash cord, and it is this that is to be used in the tricks I am about to describe, unless I designate otherwise.

A neat and effective trick, simple but highly mystifying, if performed swiftly and well, is what I will call the "handkerchief release." Hold your hands together, palm to palm, and fingers extended. Have some one tie your wrists together tightly with a silk handkerchief. A rope about 20 feet long then is passed between your arms, and both ends are held by one of your audience. You walk away from the person holding the rope until it is taut. The loop in the center then will be between your wrists at right angles to the handkerchief and held tightly against it.

Work your hands and wrists to show that they cannot be slipped out of the handkerchief, then walk to within a few feet of the person who holds the ends of the rope. Walk away from him again, and this time, when the rope is drawn taut it falls to the floor, while you turn and show your wrists securely tied, just as in the beginning.

This release is learned easily. As you demonstrate that your wrists are tied securely, press the heel of the right hand against the left wrist and work up the loop of the rope between the wrists until it can be seized by the fingers and drawn through the handkerchief. With the loop hidden in the hands, walk to the rope holder, and then, as you walk away, slip the loop over the top of the fingers of the left hand. The rope then will slip out of the handkerchief as soon as it is drawn tight. The photographs on page 23 show exactly how this trick is done.

A SIMPLE release, probably the oldest known to conjurors, but exceedingly effective when well managed, consists of releasing the hands when they are tied behind the back without trick knots or other handy aids. The performance of this is not especially easy, for it requires considerable suppleness of body. Practice, though, should make you master of the trick in a short time. This is a trick that should be performed in a cabinet or behind a curtain. Be careful, though, that your cabinet or curtain is so placed as to preclude the possibility of a confederate's aiding you.

When your hands are tied, you bend your body forward and work your hands down until they are behind the knees. Then sit down on the floor, cross the left leg over the right, work the left arm down over the left knee and draw first the left foot and then the right through your arms. Thus the knots will be brought where you can untie them with your teeth.

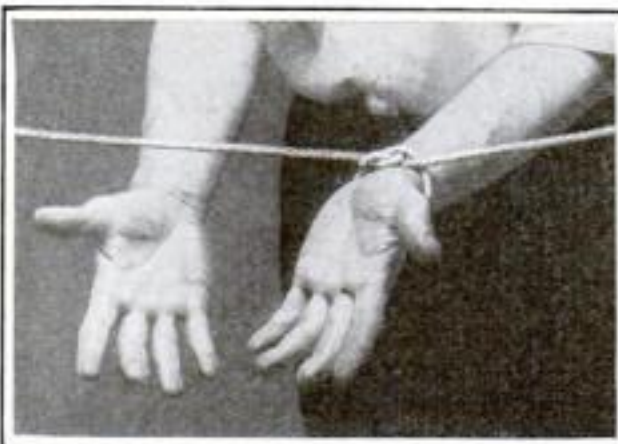
New sash cord should be used for this trick for the reason that it is so stiff that tight knots cannot be tied with it, and so smooth that you will not be hampered when you try to work your tied wrists down over your hips.

A somewhat similar effect, in that the hands are released after being tied behind the back, is performed by trickery. This is an excellent trick. By means of it you can slip in and out of coats or perform similar feats that are manifestly impossible with the wrists tied, and, at the conclusion of the trick, show your hands tied behind your back just as the committee secured them.

THIS trick is done with a piece of sash cord six or eight feet long. Extend your left arm in front of you and have some one knot the cord about it, the knot being on the *inside* or *front* of the wrist. Still holding the hands in front of the body, place the *back* of the right wrist upon the knot, explaining that this is the position in which you wish your wrists to be tied behind your body. Then put your hands behind your back in the position you have demonstrated and let the committee tie your wrists together.

The instant the knots are made, turn your back to the committee and the audience, take out your right hand and wave

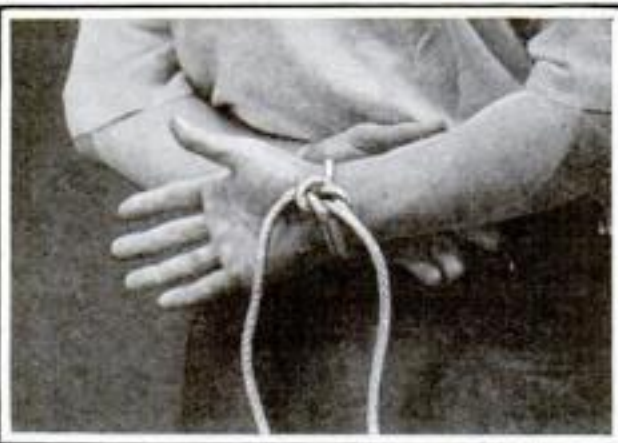
You Can Slip Out of Your Coat with Your Wrists Tied



Observe how the first knot of the rope that is to bind your hands is on the inside of the wrist



Now the back of the right wrist is placed upon the knot behind your back, ready for the committee to tie your wrists as tightly as possible



Here the wrists are tied, but before the second knot was made, you gave the rope a turn about the knot that first was made on the left wrist. This supplies two or three inches of slack, which is quite sufficient to permit you to withdraw the right hand after the second knot has been made secure

it in the air. Then place the hand behind your back again, turn around and let the committee see that the hands are tied just as they were. Or you can step into a cabinet or behind a curtain, perform any effects you may choose, and emerge at the end either with your hands still tied behind your back, or with the hands free, and the rope lying upon the floor.

The whole trick here lies in a little manipulation you make before the second knot is tied. As you place your hands behind your back, you give one end of the rope a turn about the knot that already has been made on your left wrist. This supplies you with two or three inches of slack, quite sufficient to permit the withdrawal of your right hand after the second knot is made.

When you wish to withdraw the right hand, you merely give the wrists a half turn in the direction opposite to that in which you made the turn about the knot. When the right hand is replaced in the

loop, you reverse this turn, and the hands will appear to be securely tied. This release is not difficult, though it will probably require quite a little practice before you acquire the expertness necessary to performing it in public.

THUMB ties make very effective tricks. Your two thumbs are tied securely together with cord. Then you back away and catch hoops that are thrown to you on either arm, permit rods to pass between your hands and perform similar effects that are obviously impossible with the thumbs tied. There are several methods of performing this trick. The one I am about to describe is probably the simplest.

Prepare a piece of one-eighth-inch woven cord, about a foot long, by boiling it in paraffin. This treatment leaves the cord pliable, but stiff enough to hold any shape into which it may be bent. Place the thumbs together lengthwise, with the other fingers extended in spread-eagle fashion and present your hands to the person who is to tie them, palms forward, as shown in the photograph on page 25, and request that the loop of the cord be placed about the inside of the thumbs, that is, on the palm side of your extended hands.

DROP the hands so that the thumbs may be knotted together from the top, but in doing so, slip the forefinger or third finger of the right hand inside the loop of the cord. Clasp the fingers together while the knots are being tied, and the person making the knots will not notice that you are using one finger to make a slack in the cord.

With the cord held securely between the roots of the thumbs and forefingers, it now will be possible for you to show both sides of the thumbs securely tied, for you take up the slack between your hands when showing the tops of the thumbs and draw the loop taut against the inside of the thumbs when showing the palms of your hands. In the latter case, the slack is hidden by holding your hands close to your body. With practice, you will find it fairly easy to slip either thumb in or out of the loop without detection, the paraffin holding the cord stiff enough to retain the form of the loop.

In a more difficult version of the thumb tie, the thumbs are crossed, with the right thumb behind the left, and a paraffin treated cord is wound twice around them in an up and down direction and knotted. Then a shorter cord is passed between the thumbs and wound twice around at right angles to the other cord, forming a figure eight with a thumb in each loop. Both of these cords are knotted at the upper sides of the thumbs, and the loose ends may be tied together if the committee desires.

IF YOU move the tips of the thumbs apart, like opening a pair of scissors, you will find that for all this complicated tying, the right thumb can be withdrawn from the loop and returned to it at will. When catching hoops, or performing other similar tricks your ingenuity may suggest the hands should be held together, palm to palm, with the fingers pointing upward. In this position, the thumbs are not easy to see from the front, and the

right thumb may be withdrawn just before the hoop is thrown. Then, after the hoop is caught, the thumb is replaced and you offer your hands to the audience for inspection. They, of course, are found to be tied securely still.

AN AMUSING little effect that can be introduced almost anywhere in a rope-tying program is illustrated in the lower drawings on page 23. "I was doing a few rope tricks last week," you say, "and I asked a man to tie my right wrist. He did it in this way." And you tie a rope as shown in the top picture. "Then he tied my left wrist like this," you say, illustrating by tying a second knot in the rope. You continue: "I asked him to tie the ends of the rope just as tightly and securely as he could, so that there would be no chance of my escaping. So he wound the end in and out, like this"—you make the twist shown at the bottom as you speak—"and pulled as hard as he could—so I didn't have much trouble getting away, as you see." And, as you give the rope a pull, the knots disappear and it comes out straight.

Here is another release that always is good for a laugh at the expense of those who tie you, but is effective for its mystifying qualities as well as for its comedy. Thomas Meighan and Jack Pickford, the moving-picture stars, are shown in the two photographs below, assisting me in performing this trick. You release yourself instantly, in full view of the audience after being tied securely.

A piece of smooth rope, three or four feet long, is used in this release. Place your wrists at the center of the rope, either in front of you or behind your back, and ask that they be tied tightly together. As you make this request, you draw your left hand backward and point to the right wrist just under the heel of the hand, as though designating the spot at which the knot is to be applied. As you draw your hand back, catch the rope with the left little finger and draw up a loop between the wrists. This must be done quickly and confidently, for the whole trick depends on your stealing this bit of slack, and the laugh will be decidedly on you if you are detected. With this slack, you can let the committee tie as many knots of as many kinds as they desire. You can even ask three or four persons to take hold of each end of the rope and pull with all their strength. No matter how many knots are made, or how tightly they are drawn, you can slip either hand out of the tie at will.



Houdini
Demonstrates
the Thumb
Tie Trick

The large photo shows Houdini with his thumbs extended, ready to be tied with a paraffin-treated cord. Note how with his finger he is making a slack in the cord. Below you can see the thumbs seemingly "securely" tied



Always you can be sure of a good laugh if you conclude this trick as follows: Have your committee pull on the ropes until they are well nigh exhausted. Then say, "Are you sure the knots are tight?" And, when you have received an affirmative assurance, nod, smile, and say, "All right! I'm glad you're satisfied with them," and release your hands, roll the rope into a wad and throw it away with a careless air.

ASACK release supplies just about as good a trick as I know for bringing a performance of escapes to a close. Here is one that is very easy, but requires that you have a confederate or an assistant. Use a sack of rather thin material. A duplicate of this sack is concealed in the back of your coat with the mouth just inside the collar.

You step into the sack in which you are to be tied, and your confederate pulls it up around you. When the mouth is as

high as your collar, your confederate takes hold of the concealed sack and pulls both bags up over your head. The inside sack is pulled about six inches higher than the other, and a handkerchief is wound about both of them and tied as tightly as possible. This holds the sacks together and conceals the fact that there are two of them. The mouth of the upper sack then is tied by members of the audience with stout cord *above* the handkerchief, and the knots are sealed.

Then you are placed behind a curtain or in a cabinet. It is only necessary for you to pull the neck of the outside sack through the handkerchief, hide it under your coat, and walk into view of the audience, with the other sack over your arm, with the mouth still tied tightly with handkerchief and cord.

ANOTHER easy sack escape can be made with the aid of a piece of broomstick that is covered with the same material of which the sack is made. You keep this stick concealed until you have stepped into the sack. Then, when your confederate or assistant gathers the mouth of the sack above your head, thrust the broomstick into the opening, and let the committee tie cords around the sack.

When the curtain is closed about you, pull the broomstick out. This will give you sufficient slack to pull the mouth of the sack through the cords. Then, when you are out, you can work the mouth of the sack into the cords again, leaving everything apparently as it was before your escape.

Probably I should append a word or two of warning: Even after you have acquired considerable proficiency at making escapes, *don't try any hazardous feats*. Don't try under-water escapes, round-the-neck rope escapes, or similar effects. I perform such escapes, it is true; but I have devoted my whole life to training for them.

I know of at least six persons who were killed trying to imitate my feats. Three of them were drowned, attempting to perform under-water handcuff escapes. Two men were hanged not long ago trying to escape from a "hangman's tie" in imitation of one that I perform. Only a few months ago I heard of a girl in Washington who swallowed a half-dozen needles while attempting to do my needle trick. So, if you're ambitious to become an amateur mystifier, stick to the simple tricks. Don't try dangerous rope ties. There is fun and glory enough in the safe tricks.

The "Full View
of Audience"
Release

The picture to the left shows Tom Meighan and Jack Pickford pulling on the ends of the rope with which the magician's hands are tied behind his back. On the right, Houdini is telling the movie stars how he stole the slack that makes the trick possible. A full explanation of the trick is given on this page, an explanation that will enable you to perform this astounding release without much effort



It May Pay You to Burn Oil

*The Merits of This Fuel over Coal for Your Furnace
Are Carefully Set Forth by an Expert*

BY COLLINS P. BLISS

The author of this article is Director of the Popular Science Institute of Standards and professor of Mechanical Engineering at New York University

ANY man can keep his house warm with coal—if he can get the coal. But modern science now has come to the front with a system of house heating that may revolutionize the home life of whole communities. Coal shortages will no longer worry any one. The ashman will be a relic of the past and our children may never know the discomforts of getting up on a cold winter's morning to go down and wrestle into life an almost dead fire in the furnace. Our cellars may become living-rooms, as clean as any other part of the house.

All of these marvels are in sight as a result of the tremendous strides that have been made recently in the perfection of oil heating apparatus for use in the home. It now is possible to install a fuel burning outfit so completely automatic that the home owner need only give a minimum amount of attention as compared with coal firing. All winter long the thermostatic control will turn the heat on and off to keep the house at any desired temperature.

You will not have to struggle with a furnace fire to keep it down to the point where the house will not be too hot during unseasonable warm spells. If you have an oil heating outfit, and the weather turns warm suddenly, the automatic control will put the heater out of action completely and bring it back with equal promptness just as soon as a cold snap unexpectedly sets in.

With a properly installed oil burner, you could, for instance, go away over a week end during the coldest weather, with the assurance that the temperature of the house would be maintained sufficiently high so that there would be no chance of the water pipes freezing.

Contrast this situation with the troubles you have with coal under similar conditions: Radiators and boilers must be drained, and so must the water pipes. And when you come back from your trip,

the house will be so cold that it will take a day or two to get it really warm again.

Of course there are sections of the country where local conditions are such that wood or coal or natural gas are so cheap that burning fuel oil to heat the home could be classed only as a wasteful luxury. In other sections the commercial distribution of fuel oil has not been carried to the point where the home owner can profitably obtain the advantages of fuel oil.

Where fuel oil is available at reasonable

prices there are two ways to look at the question as to whether it may be worth while. One is to figure it out on a dollars-and-cents basis, setting aside the matter of convenience; and the other is to consider that convenience has an actual monetary value.

The chief advantage of oil for home heating is that it requires so little attention. This is true of coal also, if you hire a furnace man; but most people have found that the average furnace man is careless, inefficient, and not to be compared with the accurate regulation of the oil burner installation.

There is just one way to figure if you can afford the advantages of fuel oil heating for your home. And that is to make up a comparative table that will show you your present costs, as they actually are, and a fair estimate of the probable cost of burning oil.

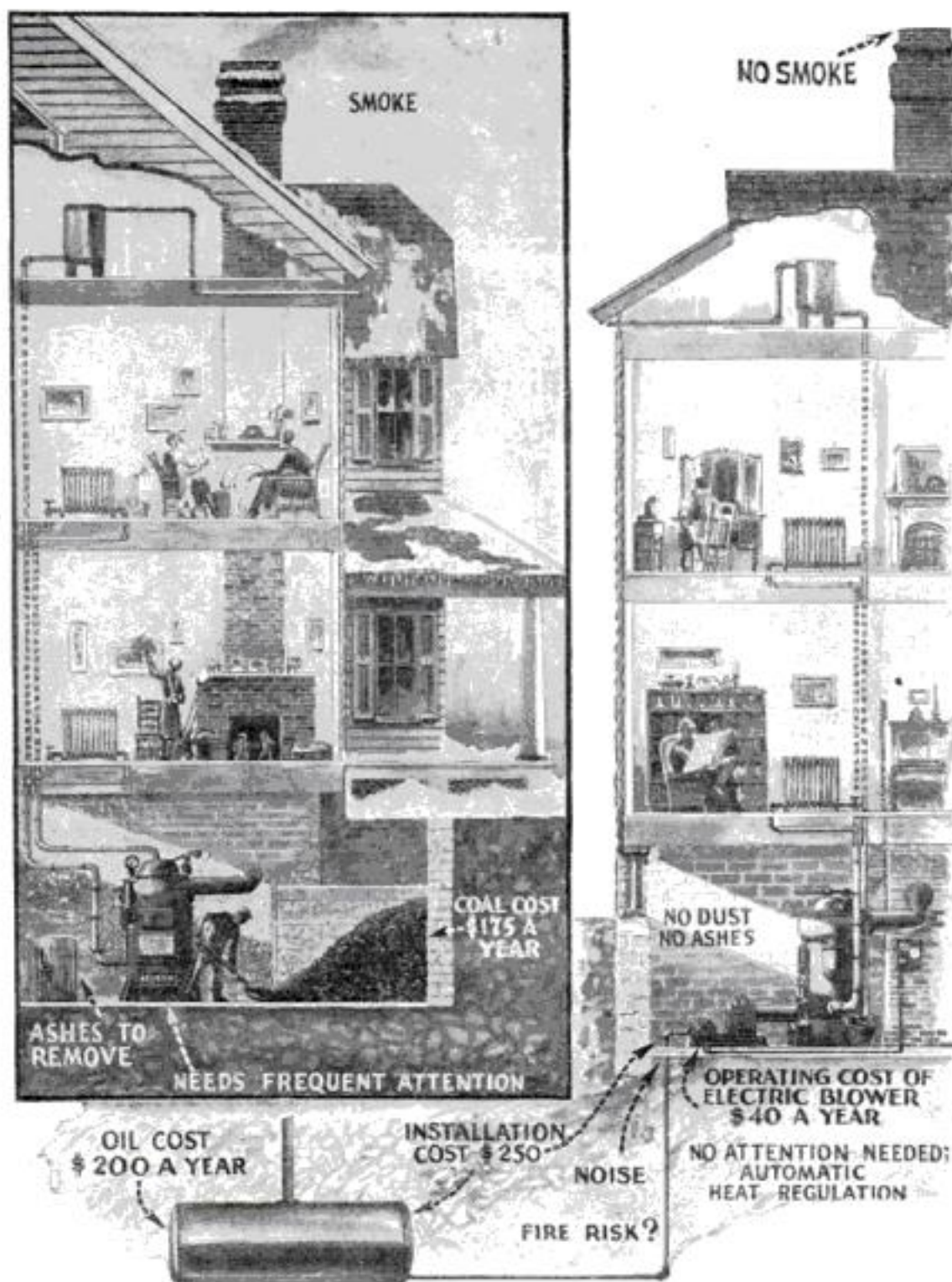
On this page you will find an illustration that will help you to list the various items of expense, and it also points out some of the relative advantages and disadvantages of the two systems.

Manufacturers of oil heating outfits claim that from 100 to 150 gallons of fuel oil have the same heat producing value as one ton of coal. About 125 gallons of oil as the equivalent of one ton of coal should be a fair average. You know how much coal you burned last year, and with this figure to go by, you ought to be able to tell pretty closely

how much fuel oil would cost annually, after you have obtained quotations from the local oil dealer.

Many of the successful oil burners use an electric motor to drive the blower, and the cost of the current needed to run the motor will have to be included in your estimate. The figure given as motor expense on the illustration was based on a cost of 10 cents a kilowatt hour, if the blower has a quarter-horsepower motor running a total of six hours a day. Change

(Continued on page 146)



Do You See the Point in This Picture?

The upper left part of the illustration shows an interior cross section of a home heated with coal. At the right is shown a house with the same type of heating plant to which has been added an oil burner and a storage tank shown below. The coal cost, \$175, was based on 10 tons at \$17.50 a ton. Oil was figured at 1250 gallons at about 16 cents a gallon. Revise the figures to suit amount of coal you use and prices paid for same



A group of children of the State Sanitarium for Tuberculosis, at Meriden, Conn., in search of health by playing in the snow in scanty attire. They sleep and go to school in open buildings. Two hours each day are spent exposed in this way in the open air

Do We Wear Too Much Clothing?

By ROBERT E. MARTIN

THEY are having a crusade in Europe. The battle cry is "Off with clothing!"

Three million persons, it is reported, have joined a nudity cult. They are swimming without bathing suits, running naked over the hills, and doing calisthenics without a thread of clothing.

It began, so far as can be determined, in Germany, with a health movie called "The Way to Strength and Beauty." This told of recent discoveries made by scientists concerning the wonderful effects of sunshine on the human body. For the first time thousands heard about ultra-violet light, those invisible rays in sunshine that increase the percentage of lime and phosphorus in the body fluids, and increase resistance to disease.

Eczema and other skin troubles are cured, rickets and tuberculosis are fought effectively, with nothing but sunshine! Window glass, it was found, shut off this curative element of sunlight. So did clothing, even a single layer of gossamer tissue.

In Germany, if you want to spread an idea, you organize. Various clubs were formed to free people of imprisoning clothes. They started sun bath and gymnasium classes. One of the largest clubs holds huge classes in nude gymnastics in a great coliseum in Berlin.

A general alliance made up of smaller societies, it is reported, now has 180 community garden colonies, 900 model playgrounds, 380 fresh air baths, and 15 holiday camps, at all of which it is the rule to check one's clothes at the door.

At first the police objected strenuously, but the cult spread too rapidly for control. Now they content themselves with arresting only those who stroll through the streets without covering. In the country, or in their clubs, the nudist enthusiasts can treat themselves to as much sunlight as they please.

NOW the idea has spread to Switzerland, Sweden, and England. Sun baths are by no means a new idea in Switzerland, which was the first country in the world to discover that tubercular children can be cured by playing naked in the snow on the mountains. But with renewed enthusiasm the Swiss tacked up signs on mountain paths: "To the sun baths."

England, too, had been interested in sunlight before German cultists began boosting it. A group of scientists long had been working to find a reason for the prevalence of rickets among London children. They discovered that smoke and fog, shutting out the sunshine, were to

*Tight, heavy garments
a barrier to health,
declare experts—Why
millions in Europe go
naked in the sunshine*

blame. They found that children could be cured by exposure to sunlight or to ultra-violet light artificially produced.

The English police objected to nudity, but last summer permitted briefer bathing suits on the beaches than ever before.

Doctor Leonard Hill, director of the National Institute of Medical Research in London, Great Britain's leading authority on the curative powers of sunlight, recently advised men to abandon their heavy dress and wear as light clothing as women do. To the women who would be healthy and beautiful, he urged: "Wear short skirts and artificial silk stockings and leave your arms and neck bare."

Women for years have been giving sunshine a chance to do its work. Now it must afford them satisfaction to learn that science abets fashion.

And men who have growled at their wives' and daughters' thinly clad ankles, tissue silk dresses and exposed throats, now are urged to shed their winter overcoats and mufflers. For medical men have found that with all the protection



This picture shows four members of the Meusendick School for Physical Culture, Berlin, Germany, taking a workout in the early morning air, wearing only loin cloths. Reasonably vigorous exercise in the open without clothing, they believe, is the best way to secure health and strength

afforded by woolen underwear, shirts, vests, coats and mufflers, men are more liable to colds and similar ailments than are women who go through the winter with neck and chest exposed.

Doctor D. F. Smiley, who kept careful records of colds at Cornell University for four years, found that as chronic cold catchers the men students vastly outnumbered the co-eds. Insurance companies in America, which keep tab on the health of 85 per cent of all the people in the country, present illuminating figures on the number of deaths from pneumonia. For the last 25 years, while women's dress has become briefer and scantier, and men have stuck to their insulation methods, the number of men dying of pneumonia has constantly been greater than the number of women dying of it. One company with 6,000,000 policy holders found that in 1924, 93.4 white males of every 100,000 died of pneumonia, while only 67 women of every 100,000 succumbed. In spite of short skirts, insurance companies still regard the expectation of life in women over 50 years as better than in men.

No better costume for mankind ever has been devised than the short kilts of Scotland, declares Dr. Walter B. James of New York City, who has made an intensive study of the relation of clothing to health. In this connection, it will be recalled that the hardiness of the Scots in the trenches was a constant source of amazement to the soldiers of the other allied nations.

Doctor James describes American soldiers in their uniforms as "hermetically sealed." "For health," he says, "they could hardly dress worse. Tight woolen clothing, puttees wrapped around legs to keep air from getting in or out at the bottom, and collar tight at the top to keep air from escaping there. The average civilian, while he seals himself at the top with a tight collar, leaves his trouser

legs open. Adequate ventilation of the body is a health necessity."

Until recently scientists believed that the bad effects of a stuffy, crowded room were caused by poison "in the air." Late investigations have shown, however, that these bad effects are due to a lack of air movement.

To function properly the body must be kept at an even and favorable temperature. If excess heat on the surface is not carried off by air, the blood becomes congested and illness results.

Changes in the temperature of the atmosphere, Doctor James explains, are met by corresponding alterations in distribution of blood in the body, so that there is always a state of balance between each part of the body and the air in contact with it. Only constant exercise will keep the nervous system, that has control of

heat regulation, fit, so that it will respond quickly. Covering the skin with poorly ventilated clothing causes it to become sluggish and inefficient.

Doctors W. B. McClure and L. W. Sauer of Chicago experimented with eight pairs of puppies to find the importance of air reaching the skin. Two puppies of the same litter were put in an incubator. One was incased in a Canton flannel coat sewed around his shoulders, trunk, and hips, leaving the legs, neck, and head uncovered.

Plenty of fresh air was let into the incubator, but all of the jacketed puppies died. The others suffered no ill effects.

Doctor Hill stresses also, the importance of the kind of material used for clothing.

A larger percentage of ultra-violet light rays penetrate artificial silk than any other material. The fewer layers of clothing worn, the better. Even a single layer of artificial silk cuts off half of the rays, and two or three layers of ordinary clothing cut out all rays.

For warmth, those materials that hold most air are best. Furs are warm because the hair part is 98 per cent air. Flannel is 90 per cent air. Wool is warm principally because its texture causes it to stand away from the skin, leaving an air layer between the material and skin. When wet it is much warmer than cotton, because it holds more air, while cotton clings.

Cotton, slick with starch or dressing, is coolest. The Arab with a single flopping garment of such material has probably hit upon the best hot weather garment in existence.

Doctor Albert Hess of New York City, who experimented with ultra-violet light on chickens and other animals, tried dressing up rats in different kinds of clothing. An outfit of nainsook cotton, he found, extended the time of exposure necessary to protect rats from rickets, from three to ten minutes a day.



Man's garments are numerous and heavy compared with woman's. That is one reason why men suffer more from colds than women, say knowing ones

Can the Eagle Fly with the Best of Them?

By PETER VISCHER

THROUGH the maze of conflicting reports concerning the air power of the United States, as compared with that of other great nations, comes the recent assurance from high military authorities that Uncle Sam is holding his own. These same authorities contend that this nation could, with a concentrated spurt, reach an equality with any rival.

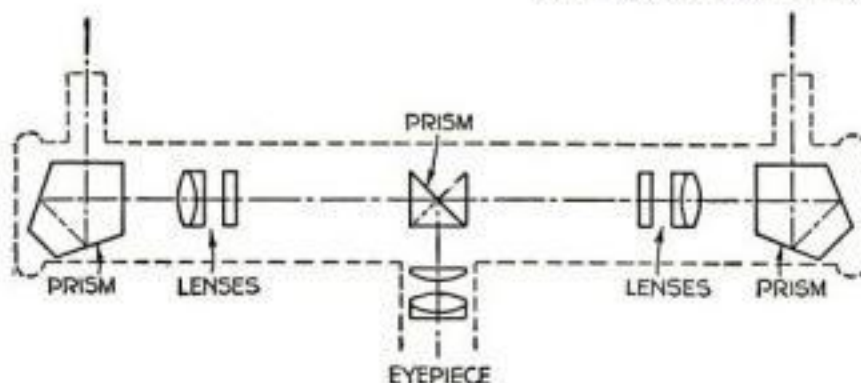
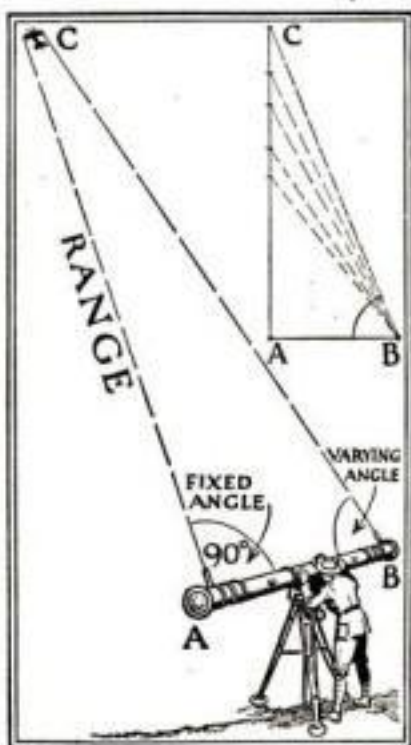
Major-Gen. Mason M. Patrick, Chief of the Army Air Service, recently gave the following figures to the Air Board appointed by President Coolidge to investigate the charges of weakness in the nation's air power by Colonel William E. Mitchell, stormy petrel of American aeronautics:

Nation	Men	Planes
France.....	36,000	1500
Great Britain...	32,000	1000
United States...	15,000	1400
Italy.....	11,000	800
Japan.....	8000	800

These are the official estimates. At the trial of Colonel Mitchell, Lieutenant-Colonel Gilmore, chief of the Supply Division of the Army Air Service, testified that the Army has 1950 planes, 75 per cent of which are war-time machines.

The figures quoted above are considered by officials of the government "the best reliable information obtainable." Using them as a basis for comparison, it is apparent that the United States is not in a precarious condition.

In two years France has added only slightly to her air personnel and has built only a few more planes. England has added virtually nothing to her personnel, though she has been busily engaged in building planes. Italy, thanks to a vigorous aeronautical program inaugurated by Premier Mussolini, has nearly doubled her air personnel and has more than doubled her air fleet. Japan has more than doubled both personnel and fleet.



How the Range Is Determined by a Telemeter

THESE two diagrams explain how the telemeter determines the range of an aerial target by triangulation. In the upper diagram the range finder is seen to form the base AB of the triangle ABC, in which C is the target. At A and B are prisms that direct rays of light from the target to an ocular prism and eyepiece at the center, as shown in the lower diagram. The prism at A is stationary so that the angle at A remains fixed at 90°, while the prism at B is movable, making it possible to vary the angle at B. The operator, looking into the eyepiece, at first sees two images of the target C, one directed from the prism at A, the other from the prism at B. He then adjusts the prism at B until the two images of the target coincide. The base AB and angle at A are constant, therefore determination of angle at B makes possible direct calibrated reading of the range AC in yards. Because of the shortness of the base line compared with range, determination of the angles calls for an instrument of remarkable precision.



Ingenious Range Finder for Aircraft Guns

An example of American ingenuity in aeronautics is this new instrument, the telemeter, which gives direct reading of an aerial target's range.

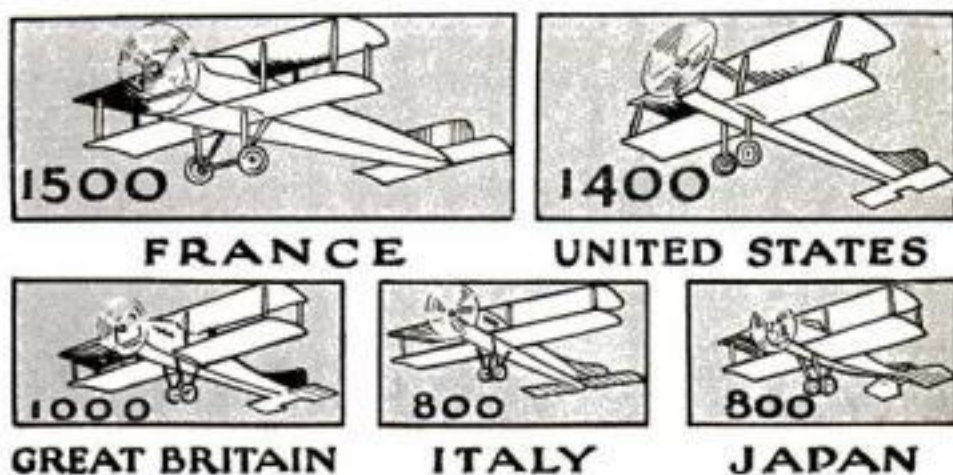
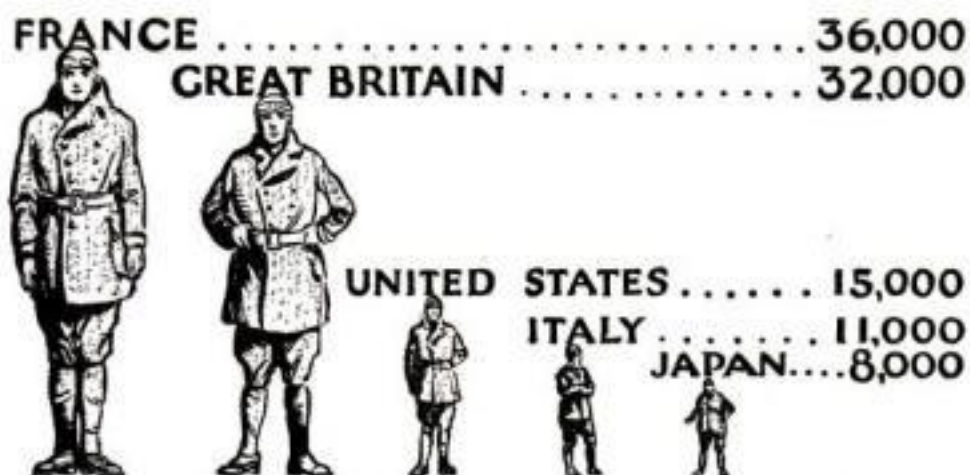
In 1923 reliable figures ranked the air power of the leading nations as follows:

Nation	Men	Planes
France.....	33,500	1250
Great Britain...	31,000	600
United States...	14,325	810
Italy.....	6500	250
Japan.....	3100	250

However, air power does not depend entirely on personnel and ships. A huge building program at the present time might not give the United States immediate supremacy in the air. Planes built today may be obsolete in a few years, so fast is progress.

American progress in aeronautics is well illustrated by the stirring victories scored during the last few months in the Pulitzer air races at Mitchel Field and in the races for the Schneider Cup at Baltimore. In one race Americans introduced the fastest land plane yet built, and in the other they demonstrated that the machine is readily convertible into the fastest seaplane yet invented.

Also some of the most important accessories in the science of aeronautics, such as the range finder pictured on this page, are the product of American brains.



The above illustration shows the air power of the leading nations. The human figures indicate the comparative man strength, while the size of the five machines gives the comparative plane power. If Uncle Sam ranks third in man power, he is second in plane power.

We Will Pay \$1000 Cash Each Month in a New and Fascinating Prize Contest

WE WERE talking about a famous American. Said my friend: "He is the most interesting man I know because he is so darned helpful." That phrase, *so darned helpful*, stuck in my mind.

In the letters about our \$10,000 contest on the homemaking problems of John and Mary Newlywed, I found the phrase again. Not once but many times. Thousands of folks discovered that in helping John and Mary they help themselves.

Because that contest proved *so darned helpful*, many of you asked for more. We are going to give you more. Your old friends, John and Mary, have new and fascinating problems for you to solve. Beginning with our next issue we will pay \$1000 each month for the best solutions to these problems.

The best features of our first big contest have been retained and new and unusual ones added. For one thing, through

these contests, John and Mary hope to help you do your work better and get more fun out of life by training your mind to make a record of the things you see.

EVERYBODY, everywhere, can compete. No writing experience or technical skill is necessary. All you need is a wide-awake mind. Sixty-three cash prizes will be awarded every month. You have an equal chance with anybody else to win one of them. Full details and the first complete contest will appear in the next POPULAR SCIENCE MONTHLY.

I know these contests will interest you. For John and Mary are everyday people. They are just like you and me, whether we live in Portland, Maine, or San Diego, California. Their problems are the ordinary problems that you and I encounter daily. In helping them solve their problems we shall be "darned helpful" to ourselves.
—S. N. B.

First big \$1000 Prize Contest in our March issue, published February 10. Don't Miss It!

A New List of Prize-Winners

Judges Announce 68 Further Awards in Our Great \$10,000 "WHAT'S WRONG" CONTEST

DOES it pay to keep trying? Ask Ethan W. Vars, a young machine designer of Erie, Pa.

Last June Mr. Vars entered POPULAR SCIENCE MONTHLY's great \$10,000 "What's Wrong" Contest. In the first of the four Monthly Contests he made three mistakes in his answers. In the July Contest four of his answers were wrong, and in the August Contest, although he made only one mistake, he failed again to win one of the cash prizes. But now in the September Contest, the last of the four Monthly Contests, Mr. Vars comes through with a perfect score. The judges announce that of all the thousands of entries submitted in the contest his was the very best; and so they have awarded him the first prize of \$500. The picture at the top of this page shows the winner with his son, reading POPULAR SCIENCE MONTHLY.

When we wrote to Mr. Vars for his photograph he evidently suspected that there was "something up." For he replied: "If my mind tends to wander from my pleasant work of designing tools and machines here at the Erie works of the General Electric, you may rest assured that I am wondering what the rest of the program is like, and hoping that there is a good act coming." By this time the "good act" has reached him—a check from this magazine for \$500.

MR. VARS' entry was submitted in the form of a neatly bound booklet, each page of which contained one of the contest pictures showing John or Mary Newlywed, or both, working at some odd job about the house, accompanied by short typewritten statements of the two things wrong in the picture.

The winner of the second prize of \$100, Albert T. Rowan of Garyville, La., is a mechanical draftsman for a large lumber company. Mr. Rowan's friends helped him greatly, he says, and he also made much use of POPULAR SCIENCE MONTHLY in preparing his answers.

"After looking high and low for at least one hint to the picture," he writes, "many a time I was ready to drop the contest flat. However, when these spells came on, I would forget the contest for a while, read an article or so, and then I was ready to try again."

Mr. Rowan's entry, too, was in the form of typewritten answers to the pictures arranged in a bound volume.

The third prize of \$50 goes to Kenneth L. Barrett of Fort Myers, Fla. His answers to the eight contest pictures were quite original, for each was prepared as a personal letter to John, telling him very confidentially just what he was



Ethan W. Vars of Erie, Pa., winner of the first prize of \$500, with his young son, perusing *Popular Science Monthly*

The Three Best

THE first three prizes in the September "What's Wrong" Contest are awarded by the judges as follows:

FIRST PRIZE, \$500

Ethan W. Vars
Erie, Pa.

SECOND PRIZE, \$100

Albert T. Rowan
Garyville, La.

THIRD PRIZE, \$50

Kenneth L. Barrett
Fort Myers, Fla.

Names of winners of the other 65 prizes will be found on page 142



Albert T. Rowan, mechanical draftsman, of Garyville, La., winner of the second prize of \$100

doing wrong and why it was wrong, and also pointing out the mistakes made by the artist in drawing the picture.

The names of the remaining 65 prize-winners—the five winners awarded \$10 each, and the 60 winners awarded \$5 each—appear on page 142. Look carefully and see if your name is on the list.

IN THE selection of the prize-winners, each of the thousands of entries was gone over with painstaking care. And in all cases the final decision of the judges was based on three points—accuracy, clearness, and skill in presentation.

And now, with all of the four Monthly Contests decided and the prizes awarded, readers of POPULAR SCIENCE MONTHLY will await with renewed interest the announcement of winners in the Grand Prize Contest, in which the largest cash prizes, totaling \$6000, are to be awarded. These big prizes go to the contestants who have submitted the best answers to all 32 pictures included in the four Monthly Contests. The winner of the first prize will receive \$2500 in cash; second prize, \$1000, and third prize, \$500. In addition, there will be five prizes of \$50 each; 50 prizes of \$10 each, and 250 prizes of \$5 each.

Who will be the winners?

The task of reaching a decision from some 60,000 entries is a tremendous one. The judges tell us, however, that the work of checking and judging the entries is progressing rapidly, and that they expect to reach their final decisions in time for the announcement of the Grand Prize winners in the April issue of POPULAR SCIENCE MONTHLY, published March 10.

EXPRESSIONS of appreciation have come to us in hundreds of letters from contestants who say they have found our great \$10,000 "What's Wrong" Contest not only entertaining but helpful. For this very reason we plan to present John and Mary Newlywed next month in a brand new contest, announced on page 30 of this issue. You can't afford to miss it.

A complete list of correct answers to the eight pictures in the September "What's Wrong" Contest appears below. For each picture you were asked to tell, first, what John or Mary or both were doing wrong, and why it was wrong; second, what deliberate mistake the artist had made in drawing the picture. In the list *A* is John's error and *B* is the artist's mistake:

1. *A*—John is putting on the padlock so that the screws holding the hasp are exposed. He should reverse the position of the hasp so that when the door is pad-

locked the hasp will fold over and cover up the screws. *B*—The artist has drawn a right hand on John's left forearm.

2. *A*—John is placing the shelf where it will interfere with the opening of the door. After the shelf is up the door will strike against it. *B*—The artist has drawn a left-handed auger bit in John's toolkit. No such tool is made.

3. *A*—John is inserting the tire irons on opposite sides of the tire. He should insert them about six or eight inches apart on the same side of the tire. *B*—The artist has drawn the jack under the hub cap instead of under the axle. The tire could not be removed from the wheel with the jack in this position.

4. *A*—John has placed the night latch on the door with the bolt turned the wrong way. The flat side of the bolt should be face inward; otherwise the door will not shut. *B*—The artist has drawn the keyhole in the door so far up under the doorknob that no key could be inserted in the lock.



Kenneth L. Barrett of Fort Myers, Fla., is the winner of the third prize of \$50

5. *A*—John is painting with white enamel on dark woodwork. He should

apply two or more coats of flat white before applying the enamel to prevent the dark from showing through. *B*—The artist has drawn the picture in the corner in an impossible position. To hang in such a position it would have to project through the adjacent wall.

6. *A*—John is soldering the broken heating element of the electric iron—a useless task, since the heat developed by the iron in use will melt the solder and break the connection. He should twist the wires together. *B*—The artist has drawn the gasoline torch without a suitable air-pump handle.

7. *A*—John is oiling the commutator brushes of the electric fan. They should be left dry. He should put oil in the cup provided for that purpose. *B*—The artist has drawn the oil reservoir above the shaft of the fan instead of below.

8. *A*—John is running radio wires under the rug. The pressure of feet on the ridge thus created will, in time, cut the

(Continued on page 142)



The panatrope, remarkable new electric talking machine

The New Electric Phonograph

A Remarkable Instrument Born of Radio

Instead of a cutting tool actually operated by the sound vibrations from the voices or instruments of performing artists, the panatrope records are cut by a tool that is operated electrically. When the record is played in the machine, the tiny record grooves are not

forced to supply power to a needle that operates the diaphragm and thus produces sound vibrations. Instead, the grooves simply control the movement of an exceedingly light needle which, in turn, produces a minute electric current—a

miniature electrical replica of the sound waves.

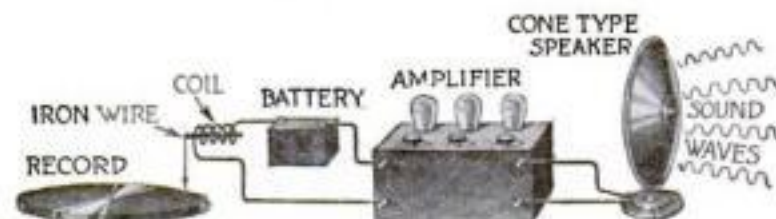
This current is fed into a powerful and distortionless audio amplifier, where it is increased thousands of times in volume.

Then this magnified output is turned into sound waves by a loudspeaker of the cone type.

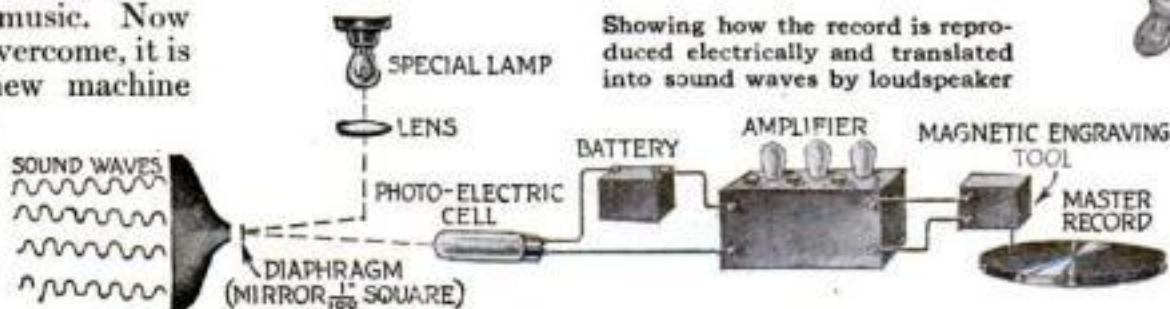
The studio of the recording laboratory resembles the studio of a radio broadcasting station. Instead of the usual microphone, however, the sound waves are thrown against the back of a tiny mirror only 1/100 of an inch in diameter. The sound waves cause the mirror to vibrate and thus move a fine thread of light back and forth across a photo-electric cell, which translates the motion of the beam of light into electric impulses. These impulses are amplified and the output of the amplifier operates a magnetic engraving tool that cuts the groove in the master record.

THE marvelously exact methods of reproduction of human voices and musical instruments made possible through engineering research to improve the quality of radio reception now have been applied to the recording and reproduction of talking-machine records.

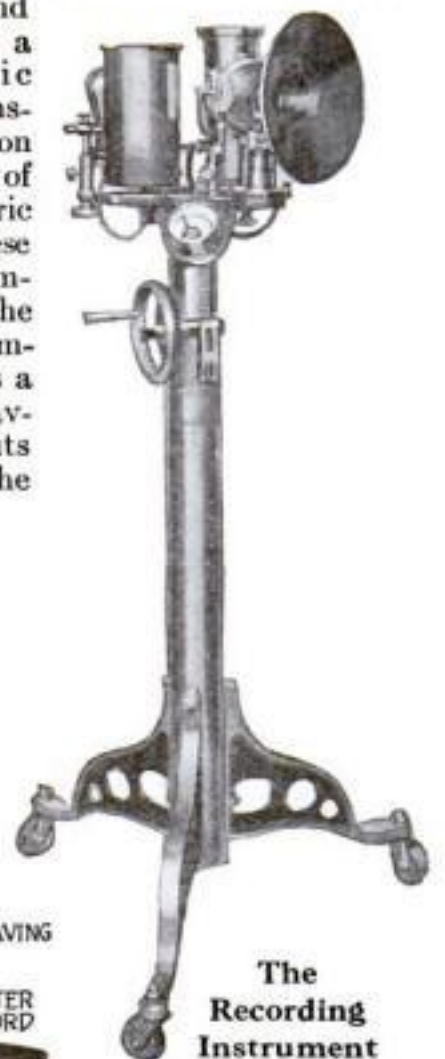
Heretofore the greatest trouble with phonographs has been metallic harshness, coupled with a failure to engrave on the record and reproduce by way of the needle and horn a large part of the complicated vibrations that go to make the sound waves of speech and music. Now these difficulties have been overcome, it is claimed, in a wonderful new machine called the "panatrope." It is a result of the combined efforts of the engineering staffs in the laboratories of the General Electric Company, the Westinghouse Company, and the Brunswick-Balke-Collender Company.



Showing how the record is reproduced electrically and translated into sound waves by loudspeaker



How the sounds are recorded electrically. The sound waves are thrown against a tiny mirror, the vibrations of which actuate a photo-electric cell. This translates varying beams of light into electrical impulses that operate a magnetic tool that cuts grooves in the record



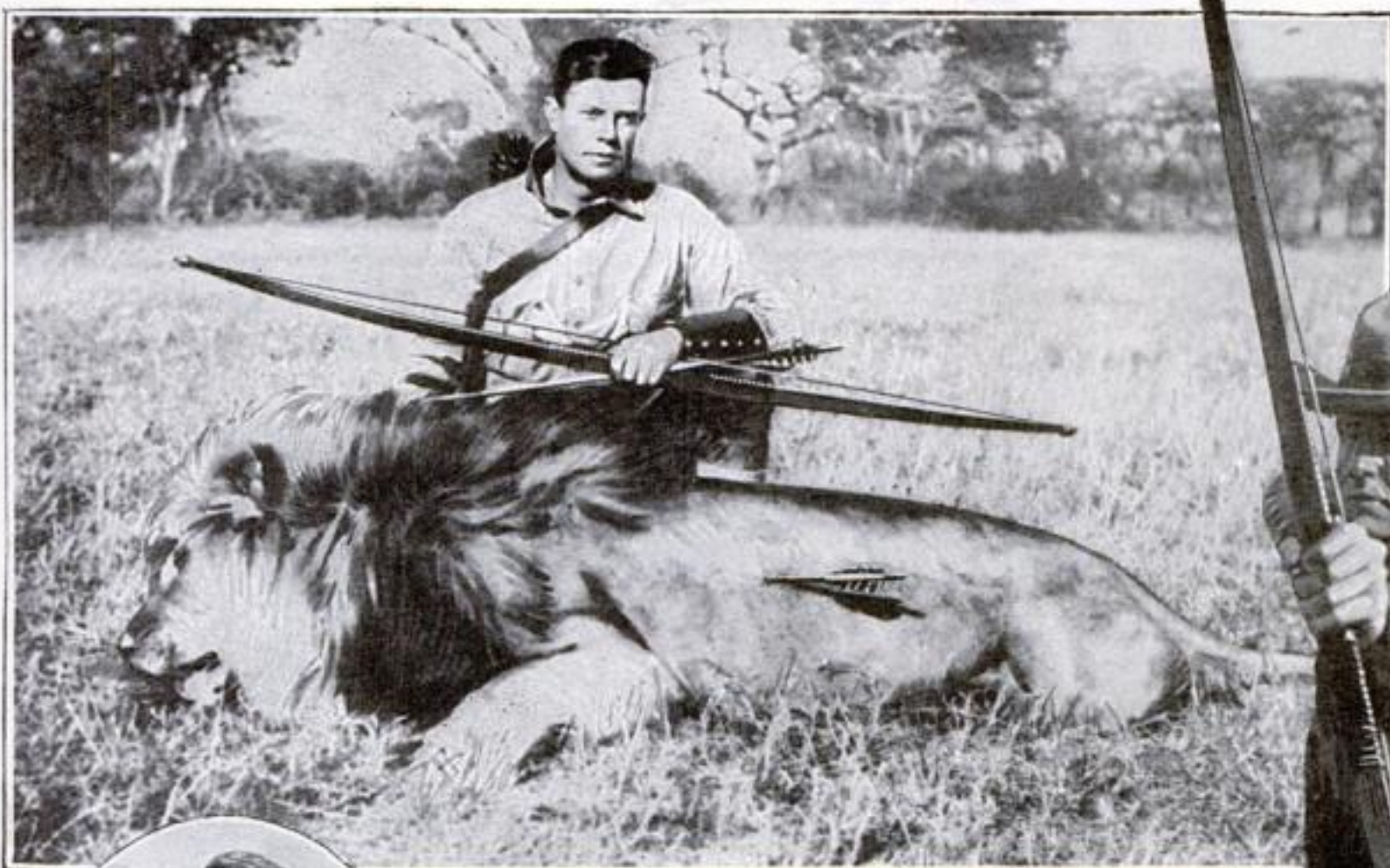
The Recording Instrument

It performs the same function as the microphone of a radio broadcasting studio

Hunts Big Game with Arrows

A Sure Shot

Arthur Young, noted American archer, in his hunting togs. His longbow is patterned after the weapon used by the English archers of old. His steel-pointed arrows may be as deadly as bullets



With a single arrow, Young brought down this lion during one of the recent hunting trips with Stewart Edward White in Africa

IN THE party of twentieth century Robin Hoods who, with Stewart Edward White, noted author, have been hunting lions and other big game with bow and arrow in Africa, there probably is none more fearless than Arthur Young, one of the most skilful of American archers. Before joining the spectacular African expedition, Young more than once had proved his deadly aim with the longbow in the wilds of Alaska, bringing down bears, moose, and other big game. Some of his exploits are pictured here.

The bow and arrows used by Young are patterned after the weapons with which the English archers won fame at the Battle of Crécy nearly 600 years ago. This bow will shoot an arrow more than 200 yards. The distance at which the archer can feel confident of striking his target ranges from 10 to 100 yards.

Facing a charging lion at 50 yards, and trusting to a pointed shaft to bring him down, is a sport that requires iron nerve, trained muscles, and unerring marksmanship.



Hooked!

Evidence of Young's amazing marksmanship. This salmon was four feet under water in the Russian River, Alaska, when the archer pierced its head with an arrow from his bow



Big Game in Alaska

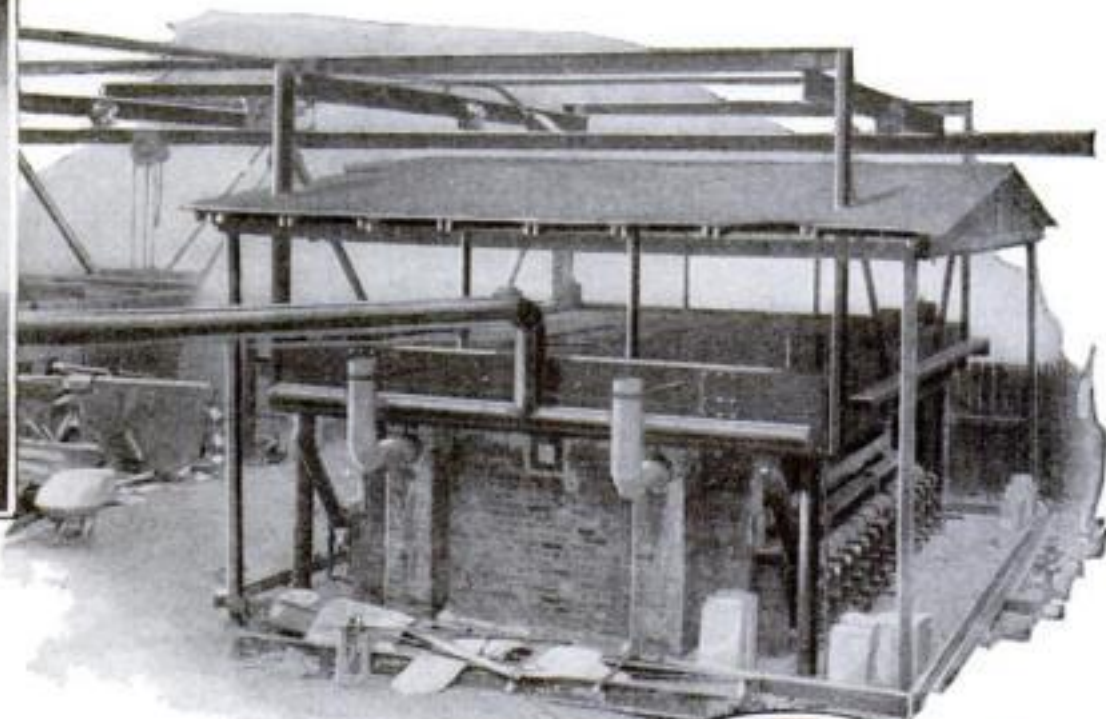
The remarkable photograph at the right shows Young in Alaska, advancing on two brown bears at a distance of a few yards. Below: A moose brought down by the bowman in the Kenai Peninsula, Alaska





How Fire-Resisting Roof Material Is Tested

This picture shows how roofing material in the Underwriters' Laboratories is subjected to the "third degree." Gas burner flames are being driven against these shingles by wind from a powerful blower. An observer notes how long it will take for the shingles to ignite, whether burning fragments are being detached, etc. To the right, a furnace for testing the fire resistance of floors, their load capacity, also their expansion



TWO hundred expert firemen, who never ride an engine or climb a swaying ladder, spend their days in a strange building in Chicago protecting lives and property. Some in oilskins and boots play huge streams of water on roaring flames. Others are unlike any other firemen you have ever seen—young men who devote their lives to pouring chemicals in test tubes or reading delicate instruments.

They are employees of the Underwriters' Laboratories, an organization maintained by insurance companies of the country, whose job it is to test inventions designed to protect your property.

To these strange firemen inventions are sent from every corner of the world. Each invention may represent months, or even years, of patient labor. But that means nothing to these men. Their job is to discover if each device will prevent, detect, or fight fire. For some weeks each invention is subjected to the severest tests to determine if it will work.

THESE strange firemen also study all possible ways in which fires may originate. When the first pipeless furnace arrived for examination, a cottage basement and first floor were set up at the laboratories, with thermometers at various points to register the temperatures. A hot fire was started in the furnace, with damper opened wide. In a home with such a furnace, a rug might have been left over the register. Therefore the engineers covered the register with a piece of heavy burlap. It caught fire in 40 minutes.

Perhaps floor sweepings were dropped in the register. Bits of paper and sawdust, therefore, were thrown into the test register. Clothing might be put over the register to dry and be forgotten. So cloths were put on it to see how soon they would ignite. Rags or excelsior might be

left next the furnace. These also were placed near the test furnace. Then the register was completely covered with sheet iron. These are only some of the tests to which that furnace was subjected before the engineers were ready to say that it offered no fire hazard.

CERTAIN tests have been standardized. Every new kind of roofing, supposedly fireproof, for instance, is given the same treatment. I saw a sample of roofing put on a wooden deck, slanted to a degree of the pitch of an average roof. Ten inches above it was a drum, glaring red, holding roaring gas flames. The roofing was subjected to this intense radiant heat until flames appeared on the under side of the deck.

A piece of lighted wood, representing flying embers in a real fire, was thrown directly on the piece of roofing and allowed to burn out. Finally, from a blower there came a gale representing a 12-mile wind, hurling a mass of flames directly on the roofing surface. Inspectors watched to see how long it took the roof deck boards to ignite, and how quickly the fire spread.

The severe test used for wired windows, fire shutters and doors at first led manufacturers to declare that no product would ever be able to pass it. When I visited the laboratories I saw a "fireproof" window under test. It was fitted in a steel frame in a brick wall, and the whole wall slid back to form the fourth side of a furnace of firebrick.

A GAS fire was lighted in the furnace, and air was forced in, making the furnace a huge roaring Bunsen burner. Flames licked the window for a whole



A Torch Test for Bank Alarms

Making an oxyacetylene attack on a bank alarm. It is a well-known fact that "yeggs" favor the acetylene torch to gain entrance to a protected vault that usually is guarded by a housed alarm contrivance

hour. At the end of that time the temperature in the furnace reached 1700° F. The glass cracked and the metal sashes bent inward.

Then the gas was turned off, the wall with the window pulled out, and the whole was deluged with water from a fire hose. Big gashes appeared in the window.

I also saw building columns tested by means of an enormous combination fur-

Firemen in the World

or Climbed a Ladder—How They Protect Our Odd Ways Mysterious Fires Start

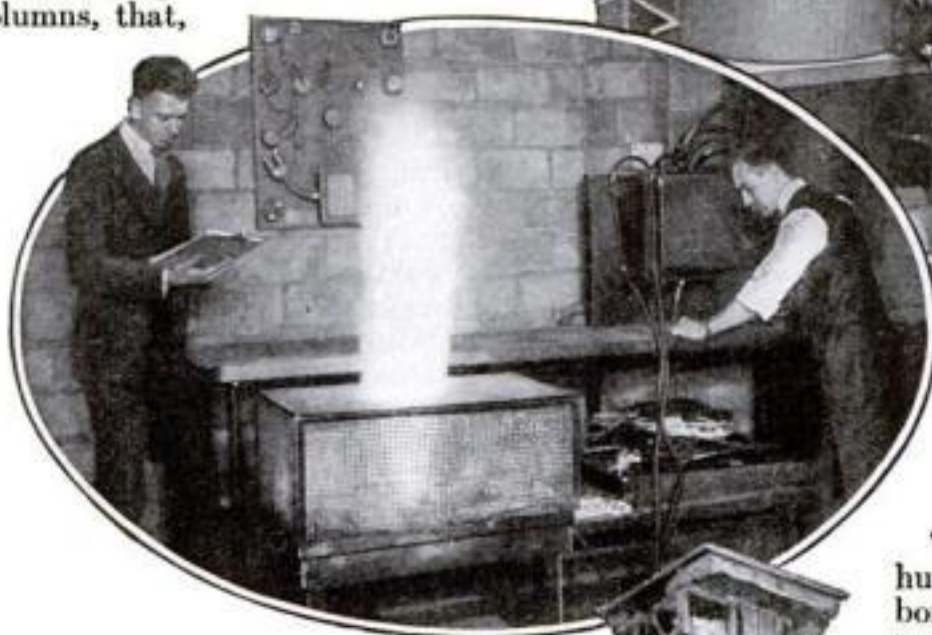
By G. B. SEYBOLD

nace and hydraulic ram. While the columns were surrounded by flames and heat equal to the most tremendous conflagration, the mighty ram bore down upon them with the weight of many stories. Delicate instruments noted the temperature and how much the columns sagged, bent, and twisted. A stream of cold water shot at the hot columns supplied the climax. A few columns, that, in spite of distortion, had managed to keep upright, shivered and fell, a shapeless mass. In their study of fire causes, these experts have found explanations that rival fiction.

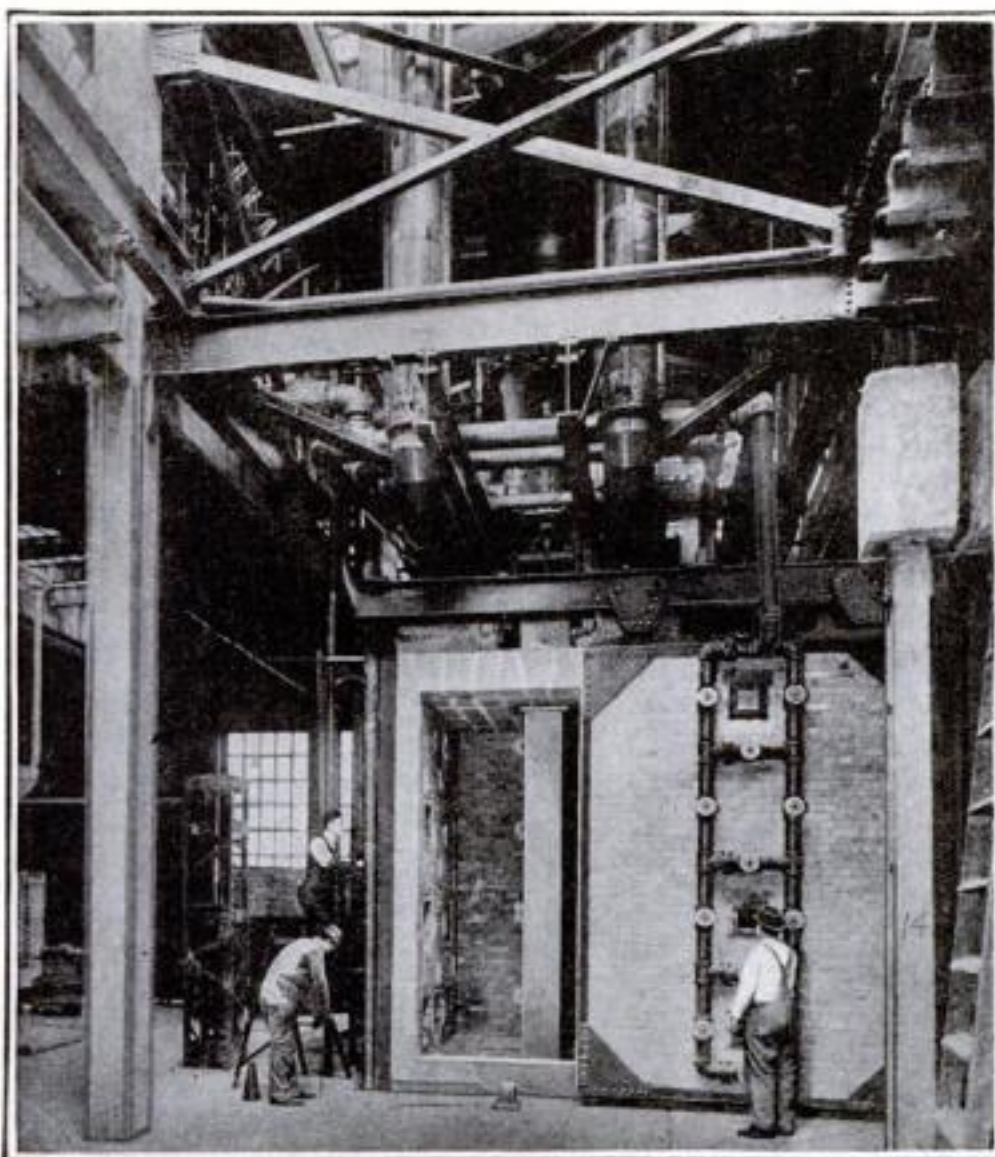
"ELIZA, a pet cat, started one of the worst factory fires I have ever seen," said George B. Muldaur, general agent for the laboratories, while showing me about the unique building.

"Oil burners, you know," he said, "have attachments to shut off

To the right: A. H. Nuckolls, of the Chicago Underwriters' Laboratory, with his invention, a camera for photographing explosive gases. The drum holds high explosive pressure. The bomb in the center of the drum is floating in oil to maintain the gases at the required temperature



In the above illustration the man to the right is testing a fuse by blowing it against the wall



Above: Combination of furnace and ram to test columns, with a deflection apparatus to show which way column will bend under heat and pressure. To the right, a photo of a column after fire and pressure tests have been applied in order to determine its exact structural value

the oil automatically. One make has a device—a can—into which the excess oil drips. When the can is full, it presses down and moves a valve that cuts off the fuel supply.

"Old Eliza was always roaming about, hunting warm spots for her rheumatic bones. One day she discovered a little space under this safety device. It was comfortable there, and the pressure of the can on her back, as it filled with oil, wasn't enough to worry about. She slept, and the can ran over. Oil kept on pouring into the furnace and soon started a fire that caused a loss of thousands of dollars.

"We have found cases," he went on, "when animals were used deliberately to set places on fire. In one town in Missouri a cottage burned to the ground while the owner was away at a picture show. It happened that he had put an unusually heavy insurance on it just the month before. The fire appeared accidental, but the insurance company had the ruins searched thoroughly.

"In the dining-room wreckage were found a lamp, a string, and a piece of meat. One bright young fellow measured the string and found that it was just the height of a table. This brought out the story.

"THE owner of the house had fixed a piece of meat to the end of a string and attached the string to a lighted lamp, which he set near the edge of a table. The meat hung dangling. Then he went off to the theater, leaving the cat alone in the house. Tugging at the meat, the cat pulled the lamp over. The astounding part was that, while the fire burned every stick of furniture, the lamp, string, and meat remained as evidence."

Rats and mice cause fires, but in the laboratories they have proved that even starving rodents will not nibble matches. "Mice may cause fires by scratching about in matches," says Mr. Muldaur.



A Laboratory Test of a Fireproof Window

A metal window frame in a movable wall has just been brought from a hot furnace to determine if the glass and metal will stand the impact of a fire stream and the sudden contraction caused by the cold water. At the left may be seen a section of the elaborate system of air and gas controls

"In New York City there is a record of a fire caused by a mouse, a cat, and a box of matches. The cat was watching a mouse that ran into a matchbox. The mouse, scrambling about, set the box on fire. The cat pounced on its prey and knocked the box to the floor, where the fire caught in a rug."

We had come to a huge room, where three engineers and two mechanics in rubber boots and oilskins were testing inventions for handling water for fire protection. There were valves and tanks everywhere, 450 valves I was told, from tiny ones, with a bore of 1/32 of an inch, to huge pieces of mechanism that required the lifting power of a 24,000-pound traveling crane to swing them into place. A 25,000-gallon concrete cistern and two 4000-gallon pressure tanks were part of the equipment used in testing out sprinkler systems.

"THE sun," said Mr. Muldaur, "sometimes starts a fire. One Sunday afternoon in an Illinois city, a fire broke out in the display window of a jewelry store. Among the window decorations was a round ball of glass with a picture under it. This had focused the rays of the sun so that it acted like a prism and set fire to tissue-paper streamers hanging at the back of the window."

"The sun isn't the only natural firebug," commented Mr. Muldaur. "Look at static electricity. The other day a big garage burned. Thirteen men were injured, and 19 cars burned to cinders because a garage workman didn't know that chamois skin and gasoline are a dangerous combination. He was filling a gasoline tank and used a chamois skin inside

the funnel to strain out the water. Friction of the gasoline falling on the skin caused static electricity. One good spark was enough to start things going.

"NEAR here is a new house, the back of which was burned off because Mrs. Johnson, who lives there, decided to wash her gloves in gasoline. She had the pan out on the back porch in the open air. She rubbed hard on a spot, static electricity was formed, and in a few seconds flames were shooting up the lattice trellis. In dry-cleaning establishments the danger of static electricity is recognized, and containers holding cleaning fluids are always carefully grounded."

"What is that?" I asked, seeing a strange machine.

"That is an electrical device for administering ether," my guide explained. "It's an invention to prevent explosions in hospitals. Perhaps you read about the tragedy in England last week?" I shook my head.

"They were using ether for an anesthetic. The patient lay on the operating table, with his throat and lungs filled with it. Ten feet away there was a tiny flame over a gas jet, where instruments were being sterilized.

"SUDDENLY a flash of fire leaped across the room. The ether in the man's throat exploded and killed him. After all, this isn't so surprising when you consider that ether spreads in the air quicker than almost any other known substance. If you should let ether drip on the back of your hand, drop by drop, with intervals of a few seconds, the evaporation would be so rapid that your hand would freeze solid in a few minutes.

"The explosion in the operating room was caused by a flashback. A screen like this made of copper will not let fire pass through. It is like the gauze used in the miner's Davy lamp.

"We usually think of explosions causing factory fires, but they are quite as likely to occur in homes, sometimes from most unusual causes," Mr. Muldaur said, and I agreed, thinking of one that had recently occurred in the home of one of my own friends.

"Everybody in our block had been expecting the fellow who lives next door to us to blow up any minute," my friend had explained, in narrating the story. "He is the kind that takes a lighted match to see whether his gasoline tank is empty.

"We had noticed him tinkering around his car one morning. Suddenly we heard an explosion, and my wife shrieked, 'Mr. Luce!' and rushed to the window. But there was Luce, polishing away, as calm as you please.

"WE WERE positive that there had been an explosion. It had rocked our house. A few minutes later my wife started to the basement for vegetables. When she opened the door to the cellarway, she saw the light of flames reflected on the wall. One whole corner of our cellar was on fire, but it was the corner farthest from the furnace.

"For the life of us, we couldn't understand it. We are cranks at our house about fire prevention. The coalbin wasn't close to the furnace. I shoveled the coal over ever so often to prevent spontaneous combustion. We didn't pile trash close to the furnace. Later we figured it out.

"The hot-water coil in the furnace had burned through.

"Water filled the furnace, and steam blew the furnace fire door open. Clear across the cellar, over by the door, waiting for the garbage collector, there was a basket of waste paper. A single coal thrown out of the furnace by the steam flew more than 20 feet and landed in this basket. Had it been at night, we'd all have been burned in our beds."

"Fires from radiation," Mr. Muldaur

(Continued on page 144)



Forty Below Zero in a Laboratory

In the above photo the men are making carbon dioxide snow, by the rapid expansion of liquefied carbon dioxide, in order to learn if extinguishing fluids will freeze in the most extreme cold weather

Nature's Dumbest Genius

*With Canny Skill the Spider
Strings Telegraph Lines, Yet
Doesn't Know Its Own Family*

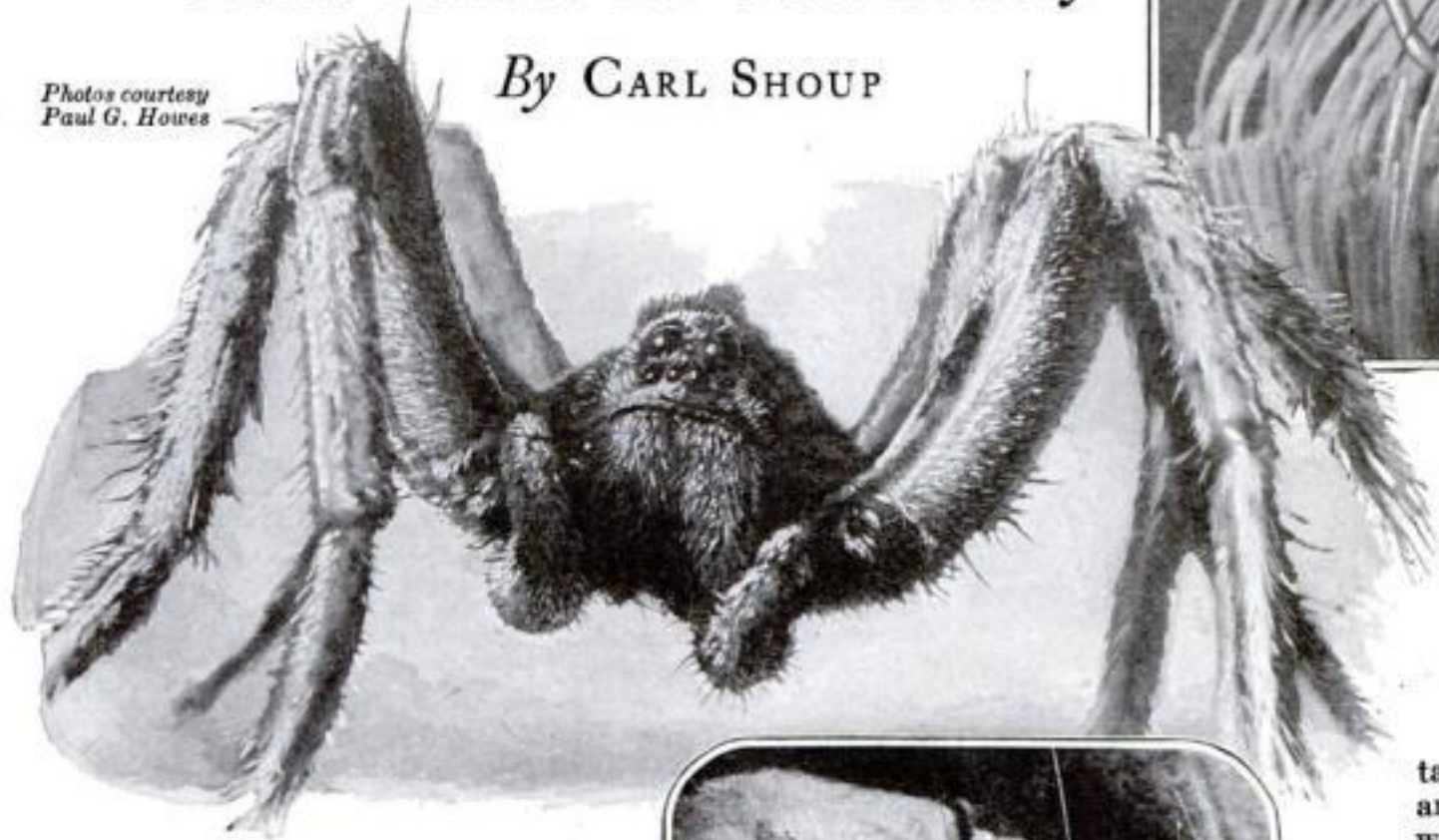
Photos courtesy
Paul G. Howes

By CARL SHOUP



An Ogre among Insects

The above picture shows a crab spider with its prey. These crafty creatures conceal themselves within the flowers and suddenly pounce upon the insects when they approach. To the left is a photograph of the small common spider much enlarged. Observe the terrifying expression with which it greets its prospective victim



A FAMOUS naturalist once decided to test the maternal affection of the spider. With a pair of pincers he tried to take from her the silk bag that she dragged along behind her and that contained her eggs, soon to be hatched. She resisted bitterly, hugging the sack up under her abdomen. So ferocious was her attack on the pincers that the investigator could hear the rasp of her jaws on the metal. Commendable mother love, bravery and intelligence, said the naturalist.

Then, after finally depriving her of her little egg bag, he tossed her another bag, taken from a different spider. This she accepted eagerly. The experiment was repeated. This time an egg bag of a different species of spider was offered in exchange for the one taken away. There was no sign of rejection. The spider was content.

Finally, a tiny ball of cork was tossed her, as recompense for the stolen bag, and she seized on it eagerly, fastened it to her spinnerets at the end of her abdomen, and walked proudly off, dragging it behind her, as though it were really a bag of eggs.

That one experiment shows how baffling a subject for investigation the spider is. Here is a creature that combines what is perhaps the most superb technical skill in the animal world, with a stupidity almost incomprehensible, and, in addition, a savagery that stops at nothing.

SCIENTISTS still are studying the how and why of the spider. Their recent discoveries seem to emphasize the fact that, whatever we may think of the spider's personality, we must applaud her for her



Eggs of the Orb Builder

The common orb building spider depositing eggs. To protect the eggs, she covers them with a cocoon of silk. Note beautiful pattern of the mother

display of weaving and engineering skill.

One of the latest authenticated stories is that of a spider capturing a mouse. It may sound impossible, but if you ever have seen a spider enmesh some huge insect by throwing a wide film of gummy silk about it, you may be willing to reserve judgment.

The mouse met its fate, apparently, while sleeping peacefully on the floor beneath a table. The spider, using the underneath side of the table as a base of operations, silently spun her sticky thread down and around the mouse's

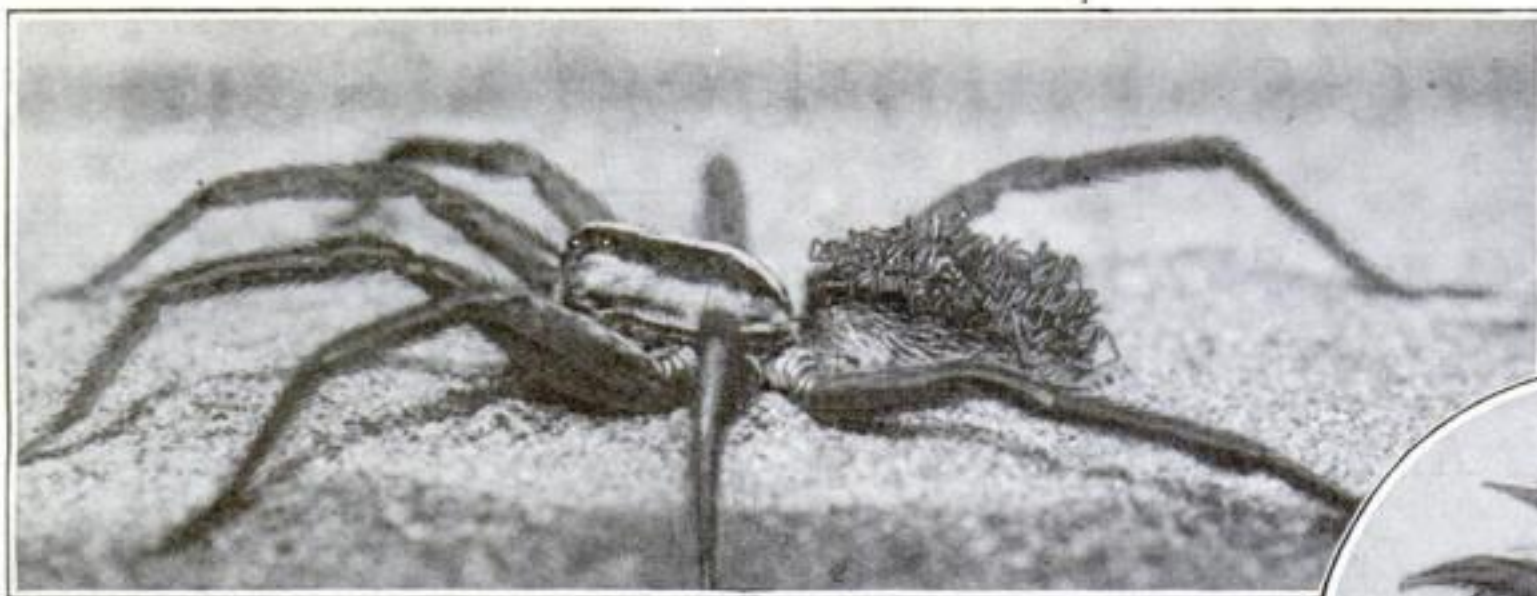
tail and up again, then down, around, and up again. Finally, when the sleeping victim was completely enmeshed, the spider was able to eat it at leisure. Even a mouse, if not too large, would find it impossible to escape from such an enveloping web.

Any ordinary spider can do the same with a large locust. The spider is sitting in the center of her web, waiting patiently. Suddenly she feels the threads vibrate wildly. She knows then that something is entangled, somewhere, in her far-flung net. Her sense of touch acts as an unerring guide for direction, and she soon finds herself facing a huge locust, which is fighting desperately to throw off the entangling, sticky threads.

HOW can the spider subdue this raging intruder? It is very simple—simple to watch, that is. She turns her back on the locust, tilts the end of her abdomen to the proper angle, and then, all the eight hundred little gland holes in the six spinnerets working at once, she emits an iridescent sheet, a sort of broad wave of silk threads, each one kept almost separate. Her two hind legs fling this shroud over the victim, while at the same time they turn him over and over. Soon the locust is helpless under this silk winding sheet.

The spider next approaches more closely, either kills or stupefies the locust by a skilful thrust of her poison fangs at a vital point, and then at leisure sucks and drains the liquid from the body. The dry remains are flung out of the web, the spider rebuilds whatever parts have been damaged, and the stage is set for another capture.

Despite her eight eyes, the spider is afflicted with short-sightedness. She depends on the trembling of the web to bring the good news. Several species



Taking the Children for a Ride

To the left: How many common spiders carry their young about upon their backs, as do the parents of higher animals. In the photo you will observe a whole flock of young spiders going for a ride



The Claws of the Weavers

Above: The claws of the web weaver. These are provided with two combs with which she spins her net, choosing at will either large or small strands. To the left: Two jumper spiders fighting over a dead bee



string a "telegraph wire" from the center of the web to a quiet retreat some eight or nine feet away. There, when an insect is caught in the silken net, the vibrations come along this single lengthy thread. The spider responds at once. She hurries down the telegraph wire to the web, thence to the correct spot, trusses up her victim and sometimes carries the prize dangling at her heels by a thread.

A SPIDER possesses one great advantage as an engineer. She carries her raw materials and tools around with her, always ready to set up an imposing structure at a moment's notice.

The "raw material" consists of the thick fluid contained in the abdomen, which solidifies into silk thread when exuded into the air. The spider's tools, her spinning apparatus, are made up of six movable warts, usually at the end of the abdomen, and, in addition, of about 130 little spinning spools on every wart. Each of these spinning spools is moved by a separate muscle, and each spool "spins" its own thread. Thus, when all spools get going together, the spider can make that broad wave of silk threads with which she swathes the locust caught in the web. All these threads can be combined into one by using the tip of one of the feet as a weaving comb. The spider can use as few or as many of the spools at the same time as she desires, depending on whether she wishes a thin or thick thread.

The thickness of a spider's thread varies between .0068 and .0034 millimeters. The finest silver thread made by man is .028 millimeters in diameter—four times as thick as the spider's thickest thread! The latter is immensely strong, for, despite its thinness, it can support a weight of from five to 10 grams.

SCIENTISTS say the first fully equipped spider did not use her spinning ability to make webs. The urge of travel, perhaps, first led the spider to perfect her spinning. When a spider wishes to go somewhere, she spins a thread into the air and waits for a strong breeze. In this way spiders have been able to "balloon" over arms of the sea and establish themselves on isolated islands. They are spread all over the

face of the earth, and have the unique distinction of living on a higher plane than any other animal, excepting birds. Mount Everest explorers found a black spider hopping about on rocky cliffs 22,000 above sea level.

IT DID not take the spider long to find that silk is excellent material for making nests to protect the eggs, for lining burrows in the earth, and for making trapdoors to these burrows. All these achievements have been perfected to a high point. A species that roams on the Russian steppes makes a hinged trapdoor for its burrow, which is kept closed by having the silk hinges of weak construction, while the lid is much thicker and heavier so that it falls of its own weight. Another species, on the contrary, constructs the hinges so that they are highly elastic, shutting the door with a snap whenever the occupant passes in or out.

The engineering skill of the spider is the best side of her character. For per-

sonality, altruism, social spirit, or intellect, the spider is below par.

CONSIDER the spider's domestic life. The female is absolute boss. That is why "she" is used in speaking of the spider in general. The male is a puny little weakling compared with her, and he has to be constantly on the watch, due to her erratic temper. It is quite usual for the female to eat the male before she goes off to await the hatching of the eggs.

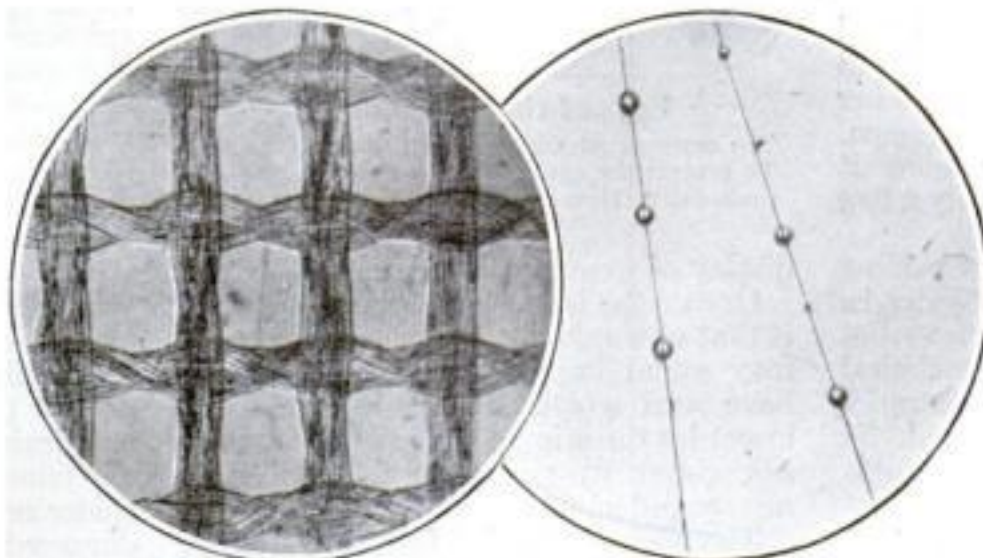
Naturally the male spider is wary of his mate, and during the process of courting he pays his addresses with extreme attention, frequently waiting for hours in her vicinity before coming closer.

How does the mother spider treat her children? In one species, at least, the exhibition seems very edifying. The children, numbering about 200, clamber on their mother's back, and for the next six months she carries them around with her, day and night.

But this maternal care is wholly superficial. If we brush the young off with a pencil, the mother spider makes no attempt to rescue her children. Some other spider's children can be substituted; the mother does not care.

The young ones seem as calloused, morally, as their mother. Suppose two mothers meet, and, like true spiders, start fighting? One of the two will be conquered and eaten by the other. How do the children of the devoured one feel about it? They will clamber down and stand off in safety, and after the carnage is complete, they will climb on the back of the cannibal that ate their mother.

(Continued on page 145)

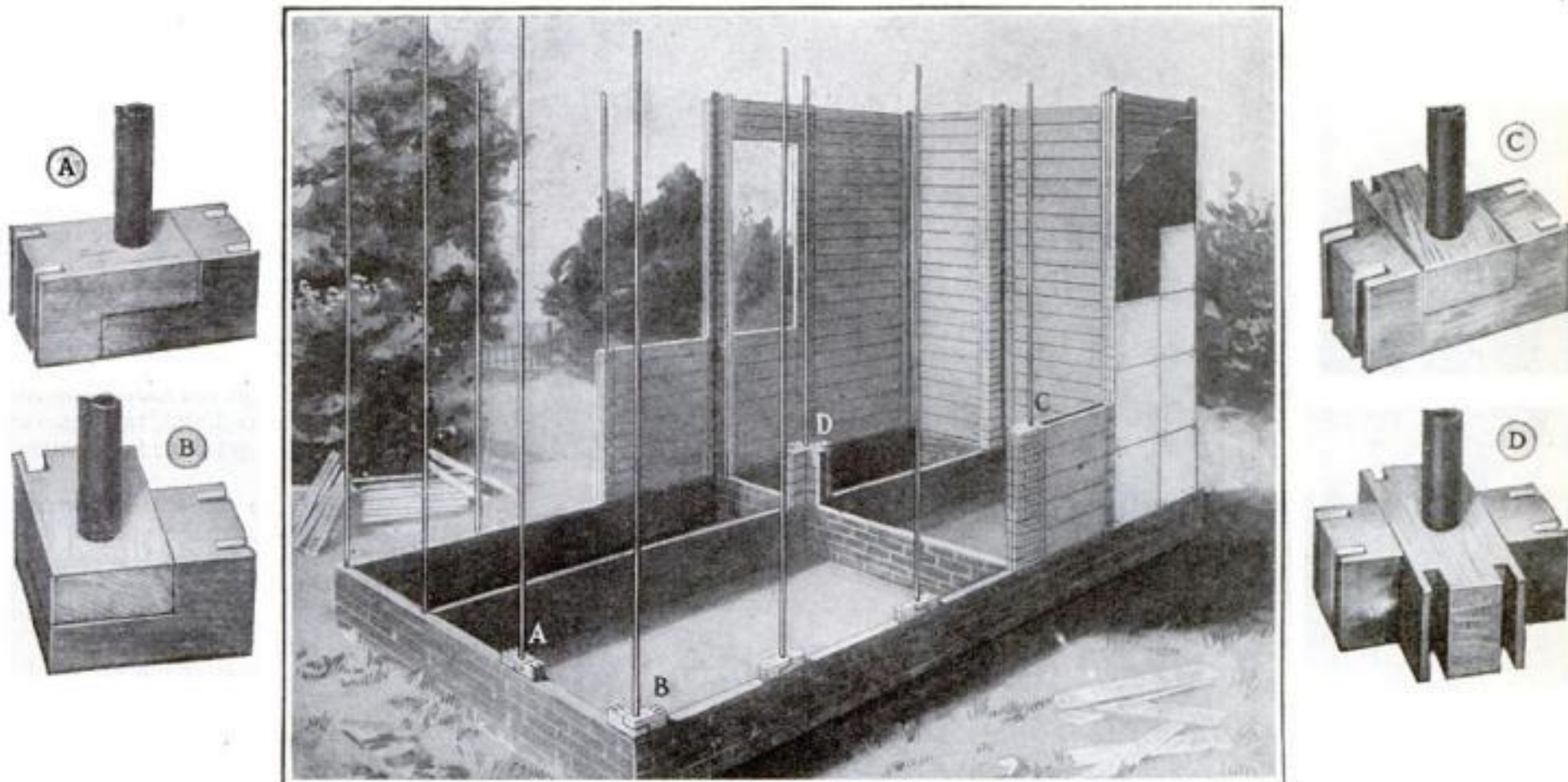


Compare These Gossamer Threads

The finest threads of silk gauze (left) are many times as coarse as the spider's marvelously delicate strands (right). Both are highly magnified. Note the droplets of glue on the spider's thread, which is exceedingly strong despite its very thin substance

A Cozy Home *Anyone* Can Build

New Type of Knockdown House Is Simple to Construct



The simple method of construction, showing how wooden panels that form double insulating walls are fitted into grooved binding blocks, which in turn are threaded on pipe uprights. The small illustrations show four types of binding blocks, and the letters indicate their location.

IN AN endeavor to solve the housing problem for the man of moderate means, M. Marcou, an attorney of Versailles, France, has hit upon the idea of an ingenious new type of "knockdown" house that, he says, can be erected for a few hundred dollars and that any man of average intelligence can build without expert knowledge.

An 18 months' test in all kinds of weather conditions proved the house to be waterproof and very easily heated.

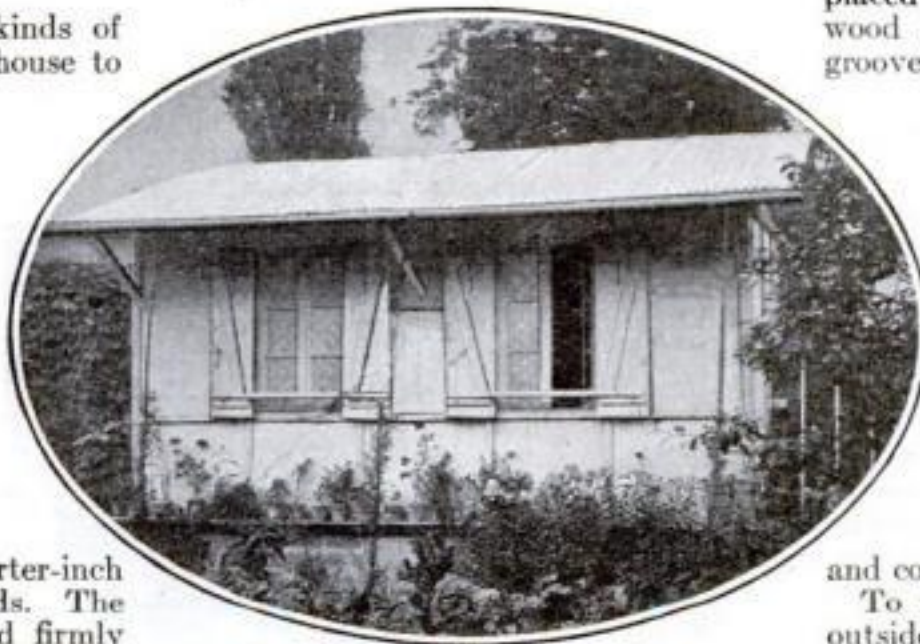
After the size of the house has been decided, the ground is leveled, and a foundation wall of brick, cement, or stone is laid to a height of about 18 inches. The top of this wall is covered with a strip of tar paper. Upon this are placed the key planks that hold the wooden superstructure firmly together. These planks have drilled holes, three feet apart, to receive the uprights, consisting of three-quarter-inch iron pipes threaded at both ends. The lower end of each pipe is keyed firmly to the plank by a countersunk screw nut.

On these upright pipes wooden blocks, drilled to fit tightly on the pipes, are threaded in pairs interlocked by halving joints. At each lateral end the blocks are provided with two grooves into which the wooden panels that form the walls of the house are slid. These panels, uniformly cut to the size of 30 by 8 inches,

form two walls separated by an air space.

The corner binding blocks are placed at right angles, and special blocks forming a T are provided for joining inside partitions to the outer wall. The door and window frames are provided with parallel grooves corresponding to those of the binding blocks. After they are placed in position, tongue strips of wood are slipped in the corresponding grooves of frame and blocks, locking the frames securely in the wall. The ceilings are wooden panels slipped into the grooves of transversal strips of timber keyed to the top of the walls. After the completion of the outer and inner walls and ceiling, nuts are screwed down tight on the upper ends of the pipes, giving rigidity to the whole structure. The slanting roof consists of boards placed side by side on a framework keyed to the walls and covered with corrugated board.

To make the walls weathertight, the outside panels are covered with tar paper and some other weatherproofing over all.



The completed house, cozy and attractive

Announcing a Remarkable New Home Building Series

WHETHER you own your own home, or are planning to build a home, or merely hope some day to live within "your own four walls," you will be interested in the remarkable series of articles on home building that will begin in the next number of **POPULAR SCIENCE MONTHLY**.

In this series an expert will discuss every phase of home building. He will tell you how to plan your home, how to

supervise its construction, how to maintain it in perfect repair. He will explain all the little "kinks" and "dodges" that make for comfort, convenience, and happiness in the home.

These are exactly the things that you always have wanted to know about the home problem. You cannot afford to miss a word of this unusual series, written by one of the country's acknowledged authorities.

—THE EDITOR.

Rungs on the Ladder of Science



A Nest of Eggs 10,000,000 Years Old

Returning recently from his fourth Asiatic expedition, Roy Chapman Andrews, noted naturalist and explorer from the American Museum of Natural History, New York City, brought with him 40 dinosaur eggs believed to be 10,000,000 years old. Included in the remarkable collection is a nest containing a dozen of the prehistoric eggs, one of which Mr. Andrews is seen examining in the picture. These recent discoveries have added new weight to the theory advanced by some scientists that Central Asia was the first home of reptiles and mammals.

Some of the month's most important discoveries and useful new inventions are presented on these pages in concise form to aid you in keeping pace with the world's scientific progress.

Laying Track by Electricity

A FEW months ago a crew of 60 men made a remarkable record, laying track on a railroad in the Ozarks in Missouri. They averaged 130 rails, or about half a mile of new track, in a day.

But the other day a gang of only 45 men on the same railroad put down this many rails in one hour! The secret was a new electric rail-laying machine, which tears up the old rails, lifts them out of the way, then puts new ones down, bolts and spikes them. The machine has a motor driven rail drilling outfit, too, that drills the usual 20 holes that are required for a new switch in half an hour.

Colored Glass for Concrete

PAUL HONORE, a Detroit artist, thinks our cities are unnecessarily ugly. With an array of beautiful colors to choose from, we make buildings gray or brown, two drab and uninteresting colors. And so he recently proposed the use of a

New Method for Laying Rails, A "Mechanical Bloodhound," and Other Interesting Discoveries

new kind of colored concrete that he calls "magesite," in which the color effects are produced by tinted ground glass mixed into it. Builders know that you can't simply pour a can of paint into concrete and get a satisfactorily colored material. For one thing, the chemicals in the paint may interfere with the chemicals in the concrete, and, second, even if the chemicals agree to let one another alone, the color afterward fades in the sunlight.

Colored glass neither fades nor washes out, says Mr. Honore, but keeps its place in the concrete as long as the building stands, doing its bit to make the neighborhood cheerful.

A Boom in "Bugs"

IN LONDON you can get a bargain in germs. A quarter of a dollar will buy millions, and you can have your choice of more than 2000 kinds.

There has been a great demand for germs lately from laboratories and hospitals, and workers in the Lister Institute are kept busy feeding, raising, and bottling them to ship to the far corners of the earth.

Many of the germs are cranky boarders, and the chef has to make special dishes for them. A favorite food is beef tea, but others will touch only dishes in which eggs are used. Topers in the assembly demand alcohol in their foods.

Some of the germs demand a lot of coddling. The "flu" germ, for instance, has to be kept at a certain even temperature in an incubator night and day lest it catch cold and die.

To Farm the Ocean

TRUE fish culture in the watery deeps, corresponding to the fertilizing, seeding, and weeding of land crops, may eventually result from the experiments of Prof. A. B. Klugh of Queen's University, Kingston, Ont. Professor Klugh has succeeded in growing, under artificially controlled conditions, the plants and animals that contribute to the diet of commercial fish of both fresh and salt water.

The investigation already has determined the part that the floating life of

"Letter Boxes" for Air Mail

MAIL dropped 6000 feet from air-planes into delivery fields on the ground may be a common thing in England if tests now being made there prove successful. These "letter boxes" would be cleared spaces used especially for mail. It is a waste of time, the British believe, for planes to make a landing every time a mail sack is delivered, so this ingenious scheme is being tried.

Details have been kept secret, but it is believed that when first released from the planes the bags will drop like stones. At a certain distance from the earth, parachutes will open so that the bags will float down the rest of the way and land without damage. Waiting motor cars then will distribute the mail.



Raises Silkworms in His Back Yard

Thousands of school children throughout the United States owe their first hand knowledge of the industrious silkworm to T. A. Keleher, an amateur entomologist of Washington, D. C., who for 26 years has been experimenting with silkworm culture in his own back yard. On half a dozen mulberry trees he raises from 10,000 to 20,000 of the creatures a year, distributing them among schools as living exhibits. The illustration shows Mr. Keleher with a pile of cocoons and hanks of silk obtained from them. Every cocoon contains from 750 to 1000 yards of silk.

fresh and salt water plays in the diet of the larger fish. The next step is to decide how much each microscopic plant, each tiny animal, is influenced by heat and cold, light and dark, acidity and salinity, and to what extent the aquatic creatures are limited by one another.

So accurately have these factors been determined in the cases of the microscopic sea plants, and of the copepods or water fleas that eat the plants and are themselves the prey of young fish, that Professor Klugh now is able to raise successive crops of both seaweed and copepods.

The method is practically that used to produce a successful harvest on land. Clean water, of the correct acidity and properly fertilized, corresponding to good soil; the elimination of growths that would cause pollution, which is virtually weeding; and the prevention of the depredations of the larger fish, just as one must take precautions against birds and beasts on land, are the measures adopted.

The foundation thus has been laid for the providing of the exact kind of diet fish desire. In salt water, the water fleas are the chief food of small herring, familiarly known as sardines, and the herring themselves are eaten by cod. In fresh water, the fleas fatten valuable fish through similar stages. Thus it is likely that the indiscriminate dumping of fry into waters where they may not thrive, now practised extensively and expensively, may give place to the providing of the proper conditions for the fish already there.

The experiments constitute one phase of an extensive program of research organized by the Biological Board of Canada, that aims to determine what the factors are that limit the size and numbers of commercial fish, so that conditions that promote growth may be produced eventually through human agency and restricting influences removed. In cases where it is not economical to interfere with natural methods, the wealth of data built up by the corps of scientists working on the scheme will provide a rational basis on which to establish conservation.

Why Typists' Shoulders Ache

TYPISTS and musicians often get pains in their shoulders, which they diagnose as neuritis.

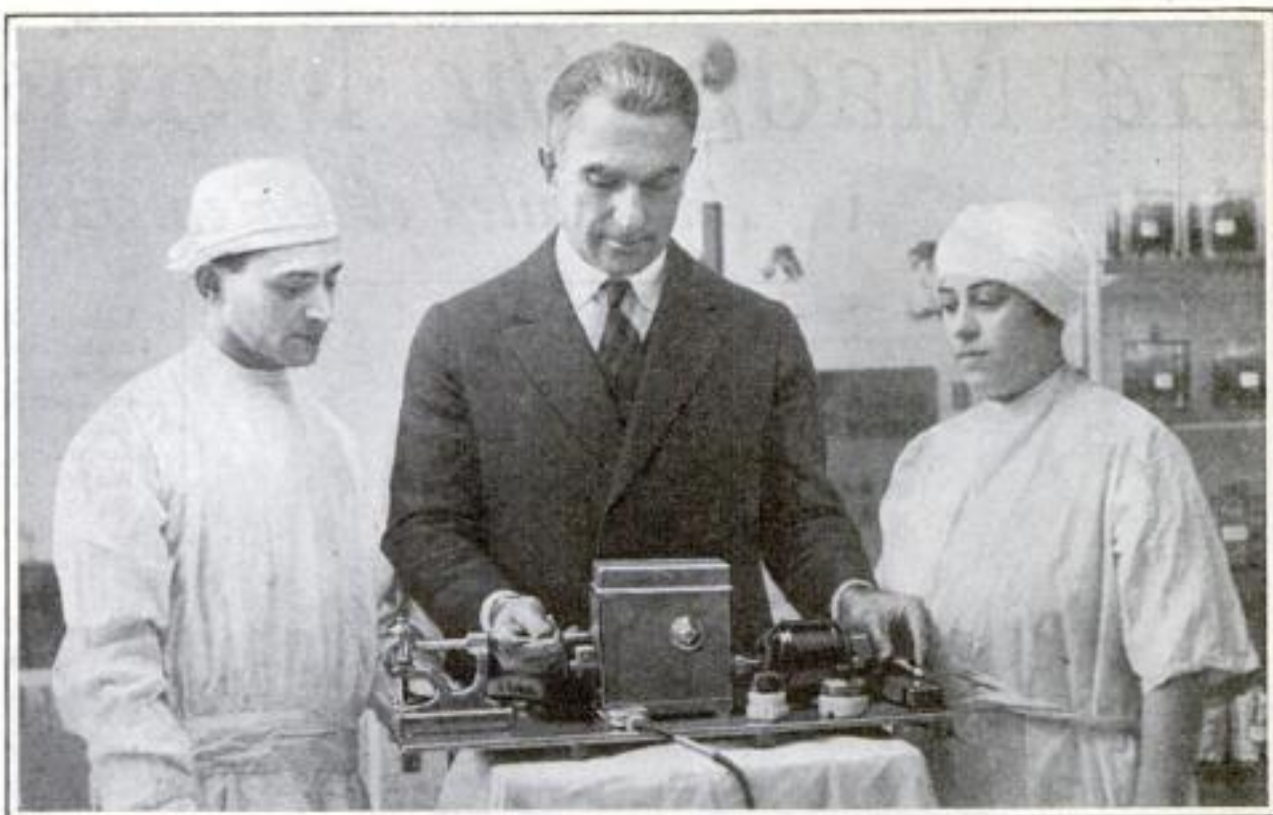
Doctor John B. Carnett, professor of surgery at the University of Pennsylvania, says the pain is caused by a deposit of lime salts that accumulates between the shoulder and arm bone on account of constant friction.

Once this deposit is located, declares Dr. Carnett, the curative treatment is found to be extremely simple.

That Elusive Vitamine A

RIDDLE: It is found in butter, but not in lard. It is in sweet potatoes, but not in Irish. It is in yellow corn, but not in white. It is in cod liver oil, but not in olive oil. Without it we should die, even if our stomachs were filled. What is it?

If you have kept up with science, you will know the answer—"vitamine A," the mysterious substance that nobody ever has seen and that chemists have been hunting for years.



Blood Transfusion by Electricity

Greater safety in blood transfusion has been made possible, it is claimed, through the use of a newly invented electrical apparatus that performs the operation almost automatically. With this apparatus, the surgeon simply inserts one needle into a vein of the donor, another into a vein of the recipient, then connects both needles with the apparatus, which then automatically measures the amount of blood as it is transferred. The inventor is Dr. A. L. Sorosi (center), who is seen demonstrating the apparatus.



Recovers Lost Radium

When a tube containing \$8000 worth of radium slipped down a drain pipe in a hospital at St. Paul, Minn., Prof. Henry A. Erickson, head of the Physics Department of the University of Minnesota, took up the trail with detecting apparatus he devised especially for the purpose. Six weeks' patient search finally led him recently to a nine-inch pipe in a sewer tunnel. He marked the pipe at a spot indicated by the detector. When the pipe was cut, the lost tube of radium was found two inches from the mark. The illustration shows Professor Erickson using his "mechanical bloodhound," consisting of an electroscope attached to an ionization chamber.

The Japanese now think they have isolated it. Katsumi Takahashi and other investigators, working in Tokio, report having extracted and analyzed a peculiar yellowish, red oil from cod liver oil, spinach, and a seaweed, that they think is vitamine A. They have named it "bio-sterin."

It will print its image on a photographic plate in the dark, giving off some sort of active rays. A minute amount of the substance has tremendous effect in the body. A millionth of a gram a day was enough to keep up the growth of rats that were dying. A drop too much caused death. The fatal dose, however, is about 10,000 times the normal ration. With such a margin, no one is in danger of getting an overdose of bio-sterin.

Noxious Plant Proves Valuable

RECENT experiments conducted by the Pennsylvania Department of Forests and Waters have disclosed the valuable pulp possibilities of the ailanthus tree, which was about to be condemned by the state authorities as a noxious plant. The department will plant thousands of ailanthus seeds, and in 25 years it is expected they will produce 43.2 cords of wood to the acre. It is estimated that the average tree grows 60 feet high and 10 inches in diameter in 25 years. The Chinese call the ailanthus "the tree of Heaven."

Historic Stones from England

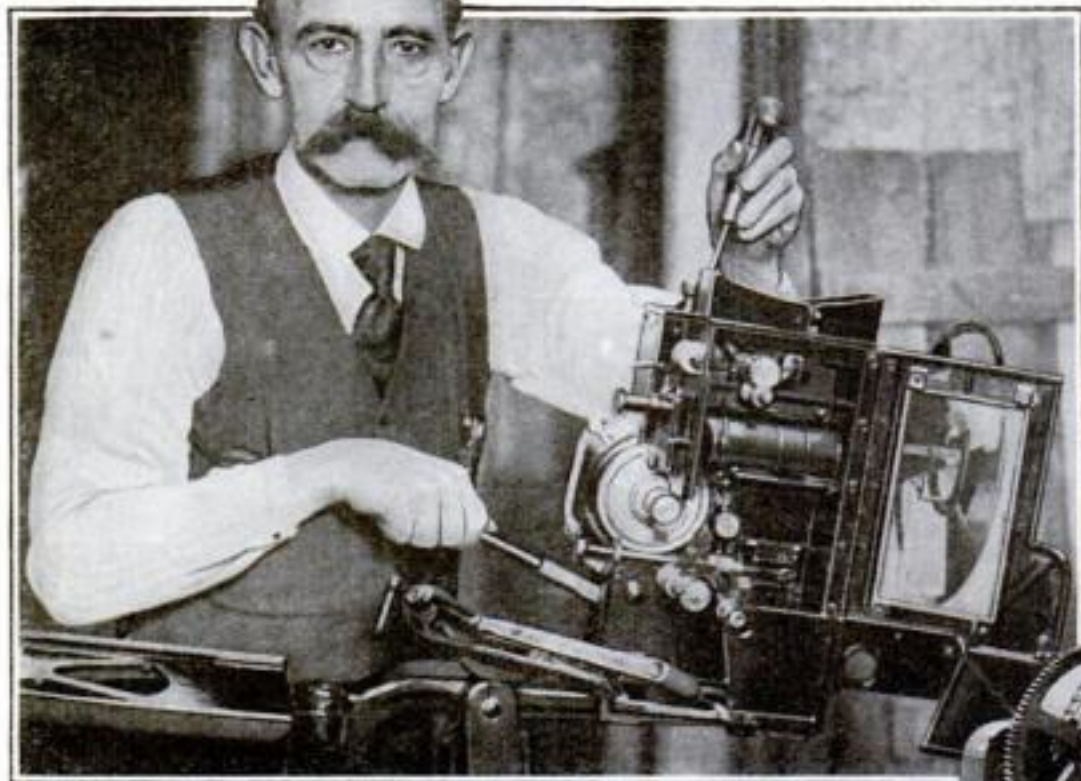
WARWICK PRIORY, a historic mansion in England, dating back to Norman times, will be torn down stone by stone and transported to America, where it will be put up at Richmond, Va., after the plan of Sulgrave Manor, home of George Washington's ancestors. Eventually, at the death of the Weddells, the mansion is to be presented to the Virginia Historical Society to house their invaluable library.

When Alexander W. Weddell, United States Consul General at Mexico City, traveling in Europe a few months ago, heard that the old mansion was about to be demolished, he bought it because the stones in it were the same kind as those in Sulgrave Manor. He wanted to build a home in this country as close a duplicate as possible of the old Washington home in England.

Warwick Priory was one of the historic buildings of England, and its venerable walls are a record of many generations. Three separate wings, one probably dating from Saxon times, one Elizabethan, and one Georgian, each display the architectural features of its period.

He Made the Movies Possible

And Failed to Patent His Invention



Jean A. Le Roy, the Precursor of the Movies

EVERY time Jean A. Le Roy sees a movie, he thinks of what might have been. He might be rolling about in a magnificent car, he might have his own yacht, he might summer in the mountains and winter on the Riviera. He might send to Uncle Sam each year income taxes in many figures. He might have been living the glittering life of a movie magnate.

Instead, he is a hard working machinist in New York City, expert at repairing moving-picture machines. And all because, more than 30 years ago, he neglected to take out a patent.

Back in '93 Jean Le Roy, as eager a mechanic then as he is today, liked to put things together. It was an odd looking arrangement of wheels, levers, and gears that he constructed, but the next year the queer machine threw a film on the screen for the first time in this country. It was

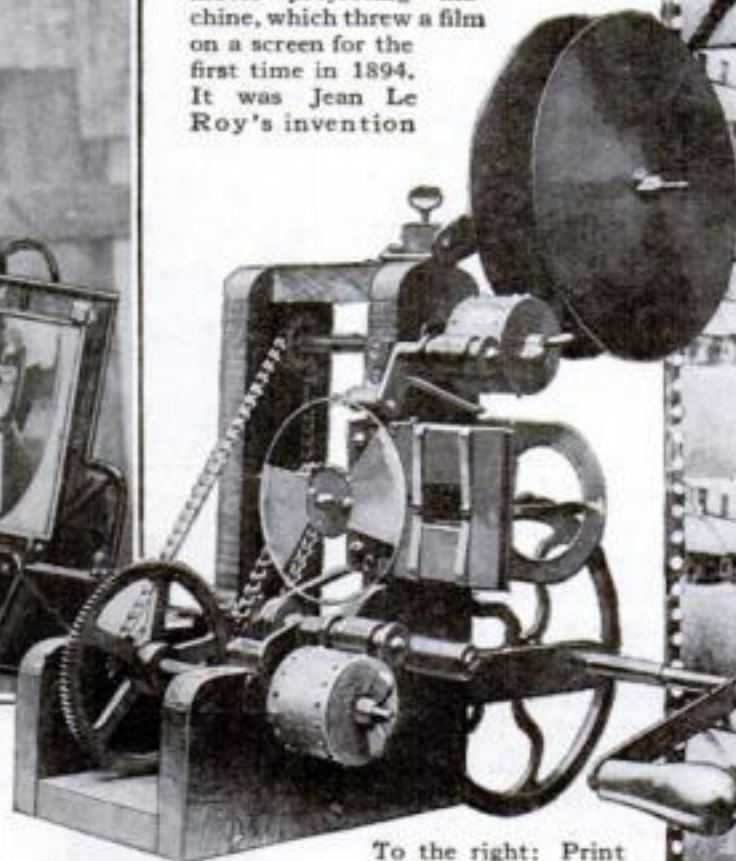
the first motion-picture projector in America, and Le Roy didn't take a patent on it.

This projector was largely responsible for the present moving-picture world. Today we have whole cities devoted exclusively to the taking of pictures, and great movie palaces, where we see plays whose production has cost thousands, sometimes millions, of dollars.

Once an idea is suggested, there are a thousand who seize upon it to alter and improve it. This was the case with the first projector. When Le Roy made his projector, moving pictures were considered either a miracle or a joke. That they might be practicable was not even considered.

When the inventor realized the value of his invention, it was already too late. He

Below: America's first movie projecting machine, which threw a film on a screen for the first time in 1894. It was Jean Le Roy's invention



To the right: Print of the first movie negative ever made and the first successful reproduction of "step motion." It was filmed in the year 1889 by Freese-Greene



invented other devices, and these he patented. He was kept poor, he explains, defending these patents against theft. Recently he patented an improvement for projectors. Almost immediately there were 26 infringements, all of which he had to fight in court.

You might think that his hard luck at missing a fortune would make this little gray haired man bitter, but that is not true. Too busy to waste any time in regrets, he works away in his little shop.

New Bank Counter Does Away with Tellers' Cages

A NOVEL type of bank counter is offered as an antidote for hold-ups, by John Poole, president of a bank in Washington, D. C., where one recently has been installed.

It has a top with two levels. The first level is a ledge on the customers' side, used for counting and writing. Money is passed over the glass surface of the second level, a few inches higher. A rail of three metal rods rests on this level.

Under the top of the counter is a recess lighted by strong electric lamps where the teller keeps papers and money. He keeps the bulk of the funds in a counter drawer in front of him. With this arrangement, the customer cannot see stacks of bills on the teller's side, as in the ordinary cage arrangement. One day, to test the counter,

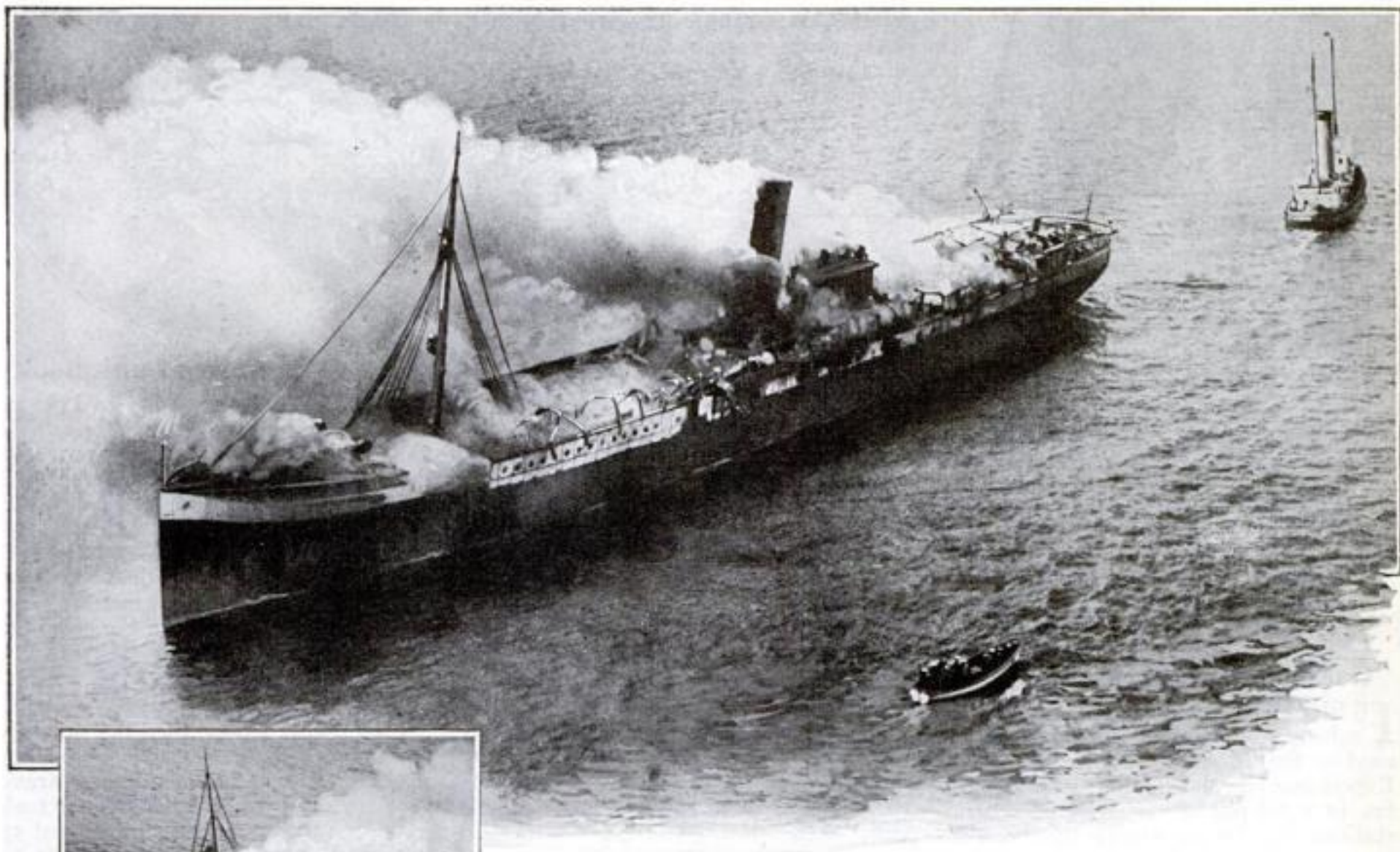
money was placed in a specimen section of it and athletic young men were told to do the best they could to get it. They found it impossible, it is said, to scale the counter or get the money.

The structural details of the new counter were worked out by Alfred C. Bossom, bank architect, of New York City.



Minus usual wickets and grills, this bank counter is the latest and most effectual protection against hold-up men

When the Cruel Ocean Takes Its Toll



The Liner "Lenape" Burned at Sea

THE S.S. *Lenape*, a Clyde liner, was on fire 10 miles off the Delaware Breakwater. Twenty ships were within call of radio, but the captain was afraid that they could not reach him in time. He drove the burning ship in a race of 30 miles; but when he reached the shelter of the breakwater, the boat

blazed from end to end. The *Philadelphia* and *Kickapoo*, trailing the doomed ship, closed in and picked up survivors. Lifeboats were lowered, and many escaped from the doomed ship by sliding down to the black water on davit ropes. Of the 368 persons on board who were in peril of drowning or being burned to death, all but one were rescued



The U-Boat that Sank the "Lusitania" Destroyed by Explosives

A THUNDERING blast and a mountain of foaming water marked the end recently of the German submarine that sank the *Lusitania*. The U-boat that indirectly caused our entry in the World War by stirring up anti-German feeling here met the same fate as its victim when it was mined and completely torn to pieces



Ever since the much discussed battle of Jutland in 1916, the U-20 has been lying in the shallows off the west coast of Denmark. For nine years it was a constant menace to shipping. The Danish Government recently decided that it must be destroyed. Divers from rowboats planted the explosive, as shown

The man in this picture is demonstrating a new invention for upholstering furniture. He is adjusting the webbing straps. The new device, which takes the place of a crew of men, stretches and tacks both the webbing and the cover



A Machine for Upholstering

SOMETIMES there is a reason for your upholstered chair sagging on one side other than the fact that you stepped on it to adjust the curtains. When the chair was upholstered, one of the webbing straps may not have been pulled as tightly as the others, and the weight of a person sitting in the chair would gradually lessen the tension of the strap in that spot.

An interesting new machine makes sure that the webbing straps are stretched uniformly and at the same time it replaces several workmen. Levers on the machine hold the straps tightly and then tack them in place. The machine can be raised to any height the work may require and one machine will handle enough work for a crew of 50 upholsterers.

POWER alcohol is now being distilled from the crushed prickly pear cactus that grows in Australia.

Combustible for Fireproofing

IT SEEMS decidedly paradoxical that a substance that is combustible could be used for fireproofing, yet such is the case. Experience has shown that even a small fire in a telephone exchange or central station, where many wires converge, may cause great damage to the wires and, consequently, a serious disorganization and interruption of the service. Many substances were tried for fireproofing the wires, but all heretofore proved ineffective.

Recently, however, selenium, the element that is used in the photo-electrical selenium cell and in other scientific apparatus, was tried as a fireproof coating for telephone wires, and proved highly successful. Wires, the cotton wrapping of which had been coated with selenium, resisted even the most intensive fire and were found intact after a fire had burned itself out. Here we have the most surprising feature of this new fireproofing method for wires—the new material used, selenium, is easily combustible.

How Helium Is Purified

HELIUM, the inert gas that is used for filling the lifting bags of dirigible balloons, such as the *Los Angeles*, is obtained from natural gas and other sources. It is delivered to the government in steel cylinders that contain the gas in a state of high compression. The commercial helium, regardless of the source from which it is derived, is never pure, but contains from 15 to 20 per cent of nitrogen and oxygen. As so large a percentage of heavier gases considerably diminishes the lifting power of the helium, it was considered of material importance to remove these impurities. A highly efficient method has been developed by the experts of the U. S. Bureau of Mines. The natural helium is subjected to high compression and extremely low temperature and conducted through a specially constructed apparatus in which the nitrogen and oxygen are absorbed by charcoal.

A GERMAN electrician has offered a suggestion for thawing frozen water pipes. The house lighting current is reduced to a low voltage by means of a transformer, and then it is sent through the frozen section of water pipe. The heat of the current will melt the ice.

Ingenious Cigarette Holder Prevents Paper Burning

THIS cigarette holder is designed to prevent the paper from burning. To the mouthpiece is attached an aluminum frame that keeps the paper in contact with it from burning, while the tobacco burns as usual. A special holder for the device clips in the breast pocket like a fountain pen or a pencil.



Electric Massage Machine Goes in Pocket

NOW you can carry your own electric massage machine in your pocket. Even if you are separated from an electricity supply, you still can have your daily massage treatment for rheumatism, lumbago, or other aches.

The ingenious little machine illustrated can be made to give either a heavy or light electric massage by simply running it over the skin. The wheel is geared to a small dynamo in the handle, which turns as fast as the wheel is run over the flesh of the patient.



The inventor of the pocket massage demonstrating his device



Novel Bank in a Bank Book

HERE is a new scheme to help you hang on to the elusive dime. This time it is a slip cover for a bank pass book. A pocket holds a coin retainer, kept in place by a sealing label. When the retainer is filled, it is taken to the bank, where the seal is broken, and the teller puts the whole sum into the bank before you can spend it. He then puts a new seal in place. A record of the coins may be kept on the seal.

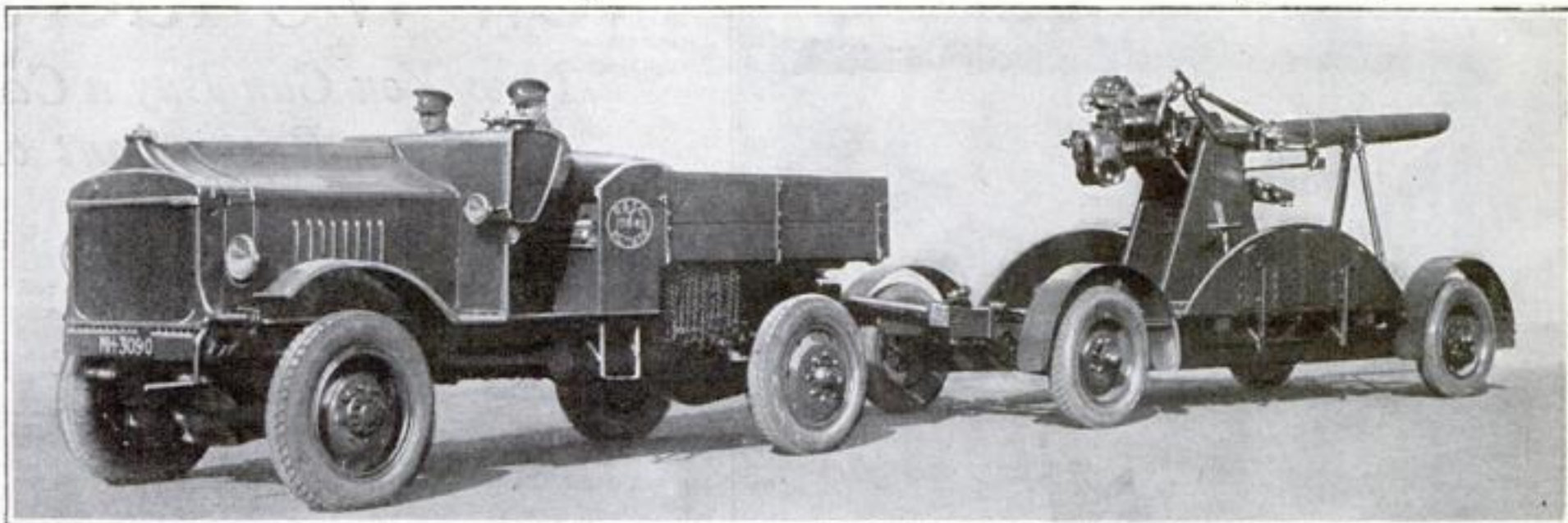
Taking the Ocean's Measure

WAVES higher than the ship, towering like mountains—you have read about them and heard ocean travelers describe them. Perhaps you actually have seen them. But be careful what you say about them, for now scientists will check up on your statements. The length and height of ocean waves have at last been measured exactly by means of a specially constructed camera, according to a German magazine.

Ordinary waves are from six to 12 feet high. In a high sea they may rise to 27 feet, or in a violent gale may reach 36 feet. This is the ultimate height of a wave. The length of the largest wave, that is, from crest to crest, is said to be 900 feet. It is estimated that it takes 20 seconds for one wave to replace another—the speed of an express train.

THE seven modern wonders of the world are sometimes listed as: the telephone, wireless telegraphy, radium, spectrum analysis, the airplane, anesthetics and antitoxins, and X-rays.

Balloon-Tired Army Tractor Travels at High Speed



BALLOON tires now have invaded the army. The above photograph shows the "Hathi," a new four-wheel drive tractor adopted recently by the British Army after exhaustive trials. It is seen

here drawing an anti-aircraft gun. Both the tractor and the gun are equipped with the big, smooth-running tires.

Remarkable claims are made for this new tractor. It will draw heavy guns

through wide streams, it is said, and can travel over rough country at high speed. It is this combination of qualities that makes the machine suitable for use in the tropics and where good roads are scarce.

Long Distance Electric Power

ELECTRIC power recently was transmitted from British Columbia to the State of Washington to help make up a shortage of power due to lack of rain in the Pacific Northwest this fall.

Invents a Shield for Doors

WHEN you have to move your furniture from room to room, it might be well to adopt Joe Wilcox's idea. Joe Wilcox is an employee of the Metropolitan Building Company of Seattle, Wash. He invented a protection for door jambs and furniture that has saved a lot of damage. The device is a four-foot length of heavy carpet, wide enough to cover the woodwork of the doorway. Three strong steel springs, well padded, are fastened at the top, center, and bottom of the carpet, and the whole is lined with canvas. The device is held to the door jamb by its own tension.



Joe Wilcox is shown above demonstrating the door-jamb protector that he invented

Playing the "Swanee tango harp," recently made popular in the city of London



A "Pep" Harp for Jazz Music

THE young lady in the picture at the left is playing the newest musical instrument. Where did this strange musical hybrid come from? The whang is reminiscent of Honolulu, but the shape is unique. The tone, which is altogether new, is said to be just the thing to put more "pep" into jazz music.

"Swanee tango harp" is the name under which the new instrument was recently introduced to London, where it has become very popular in tea-rooms, hotels, and night clubs.

The instrument has six strings and it is played with pick and steel, after the fashion of the Hawaiian guitar. It was developed specially for tango bands.

Some Facts about Carbon

BEFORE the days of dynamos and electrical furnaces it was believed that carbon in its various forms, as coal, graphite or diamond, could not be melted. It was thought that carbon, exposed to heat, would pass from the solid to a gaseous state without melting, forming various distillation products, principally in combination with hydrogen or, in the presence of air, combine with its oxygen, forming one or more of the gaseous oxides.

Messrs. A. Hagenbach and W. P. Luethy, two chemists of Basel, Switzerland, recently sought to determine the melting and boiling points of carbon by interpolating small rods of coal and graphite, 0.12 of an inch in diameter, as resistance in a powerful electric current. By this method they were able to determine that the melting point of carbon is at 6849° F., the boiling point at 7362° F. Although the investigators were not able to observe the actual melting of the carbon, the interruption of the current at the critical point cannot readily be explained by any other cause than the melting of the resistance rods. Additional evidence is found in the fact that the two investigators bent the carbon rods into the form of an S shortly before the melting point was reached and also welded the resistance rod to another carbon rod.

STEEL articles coated with various metals in different thicknesses were placed in the open at Pennsylvania State College in order to determine the effect of time and weather on them during the next 30 years.

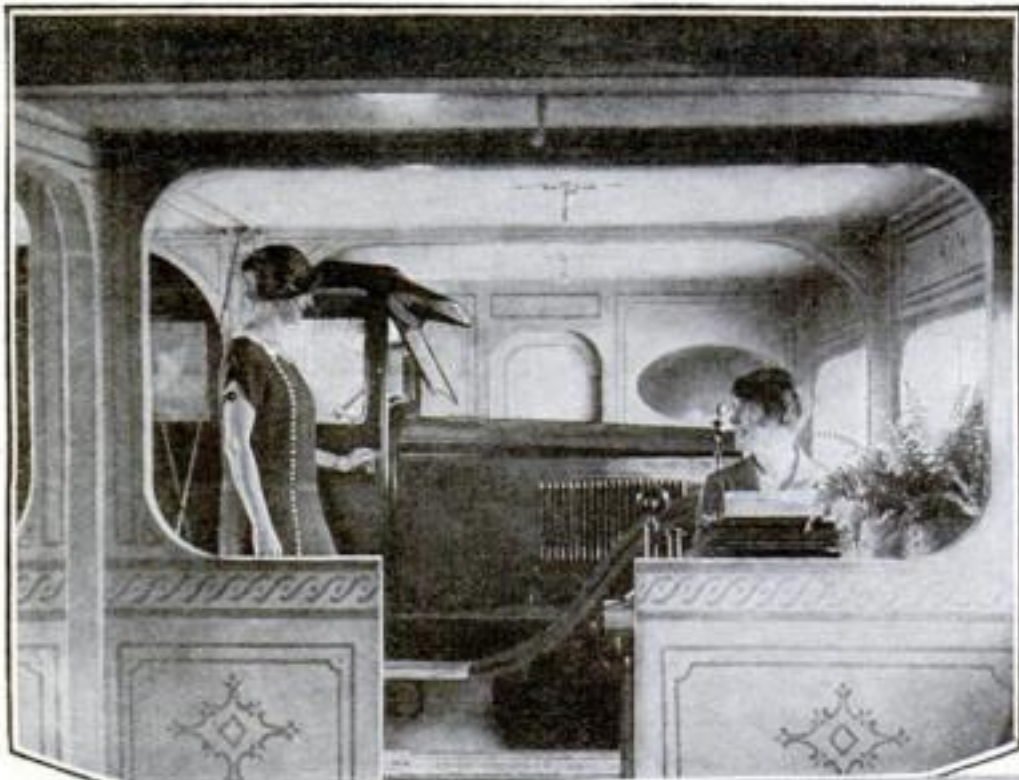
A Flat Hook for Corks

BITTLE corks that crumble when attacked by a corkscrew are nuisances, but the fault lies in the use of heavy corkscrews, according to a French inventor. He has perfected a flat hook that will pull out corks whole as well as easily, he says.

The flat hook is slipped into the bottle neck beside the cork, then turned half-way. The blunt end of the hook pushes up on the lower part of the cork, and a pull draws it out.



This device hooks out the stubborn cork

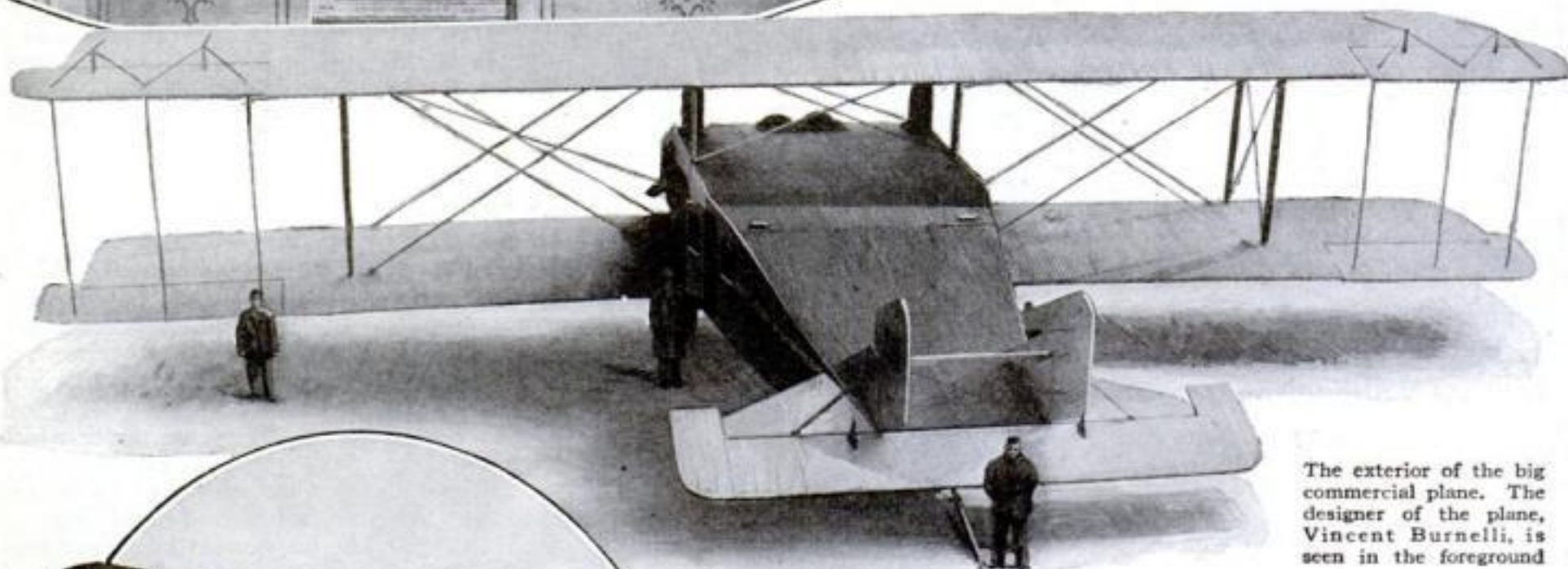


New Wonders

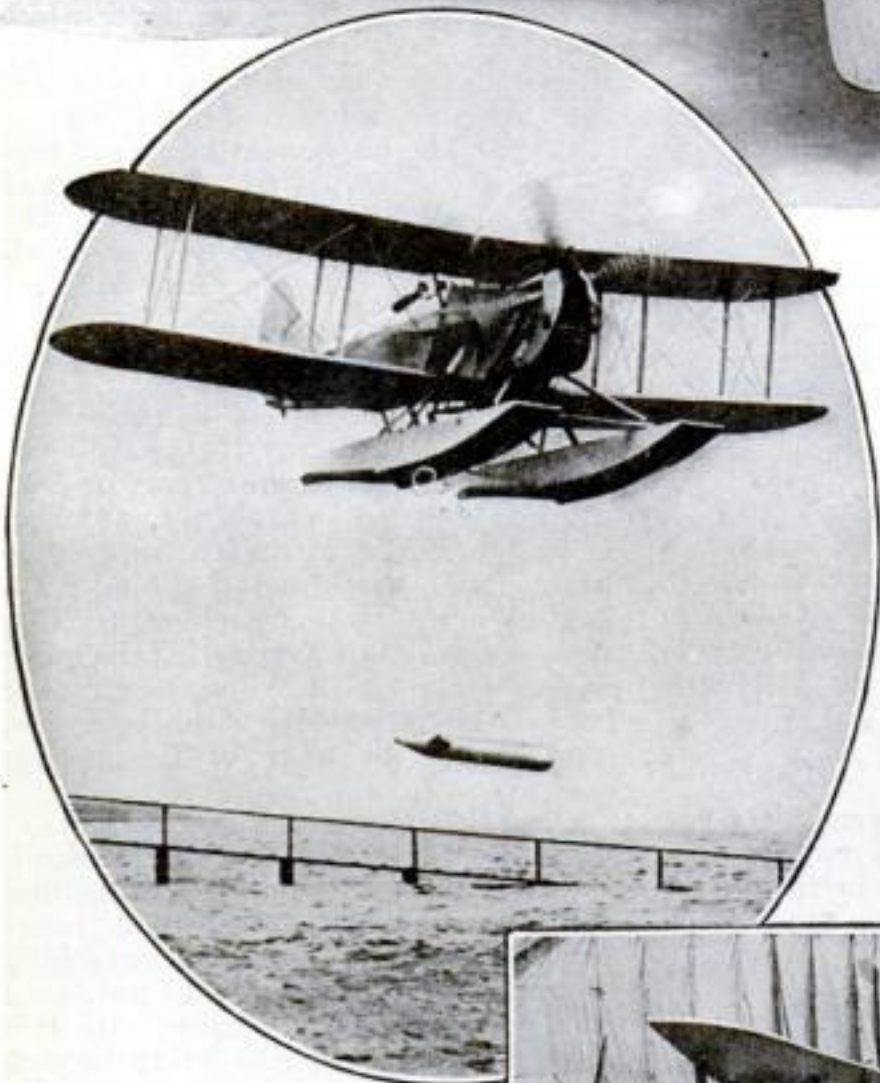
*Now You Can Buy a Car
Airplane Restaurant or*

Auto Salesroom Housed in Giant Plane

HERE is an interior view of the newest thing on wings—a real automobile salesroom housed in one of the largest commercial airplanes in the world. This monster plane pictured below has a wing spread of 87 feet. The attractive interior is fitted with all the necessary furniture of a successful automobile salesroom, and the first serial typist is shown seated at her desk. A fully equipped car awaits the critical inspection of the prospective buyer. The plane recently set out from New York on a tour of the United States, making a first stop at Boston. Conversion of a huge airplane into a salesroom marks a new step in the evolution of the airplane for commercial purposes.

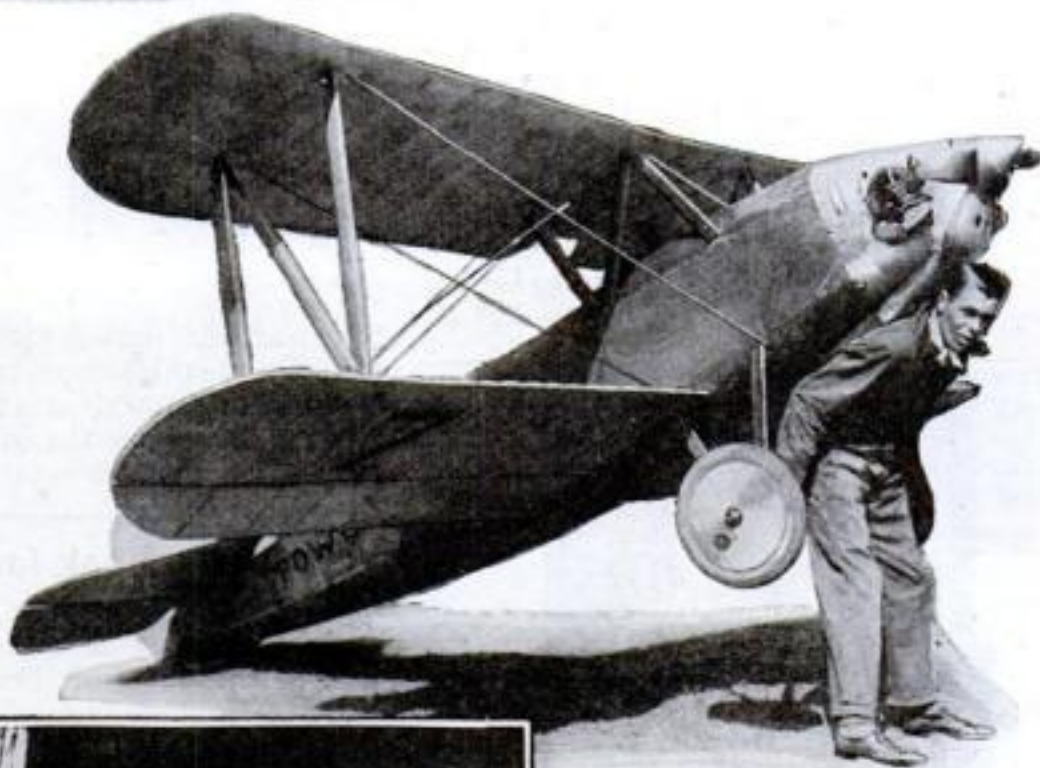


The exterior of the big commercial plane. The designer of the plane, Vincent Burnelli, is seen in the foreground.



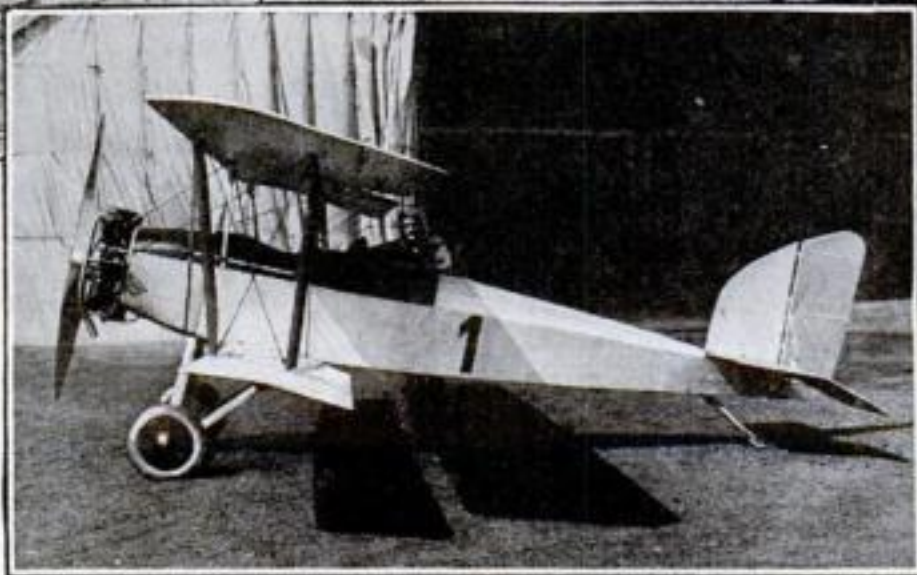
First Torpedo Plane

England claims the first torpedo seaplane, the "Blackburn Napier," shown here in its trial flight, launching a huge torpedo at the Brough Seaplane Station, near Hull, England. Besides the torpedo, carried under the fuselage, the seaplane is equipped with two guns and bombs, and can be used alternately as a bomber. With full equipment the plane can rise from the water in 20 seconds.



A Baby Sky Speeder

Flying 35.5 miles on a gallon of gas, this little plane won the speed and efficiency race in the international air contests at Mitchel Field, N. Y., recently. It goes 85 miles an hour.



From the Discard

From parts of a discarded seaplane, Albin K. Peterson, of the navy flying force at Anacostia, D. C., built the flivver plane at the left. Weight, 500 pounds; wing spread, 28 feet.

in Air Travel

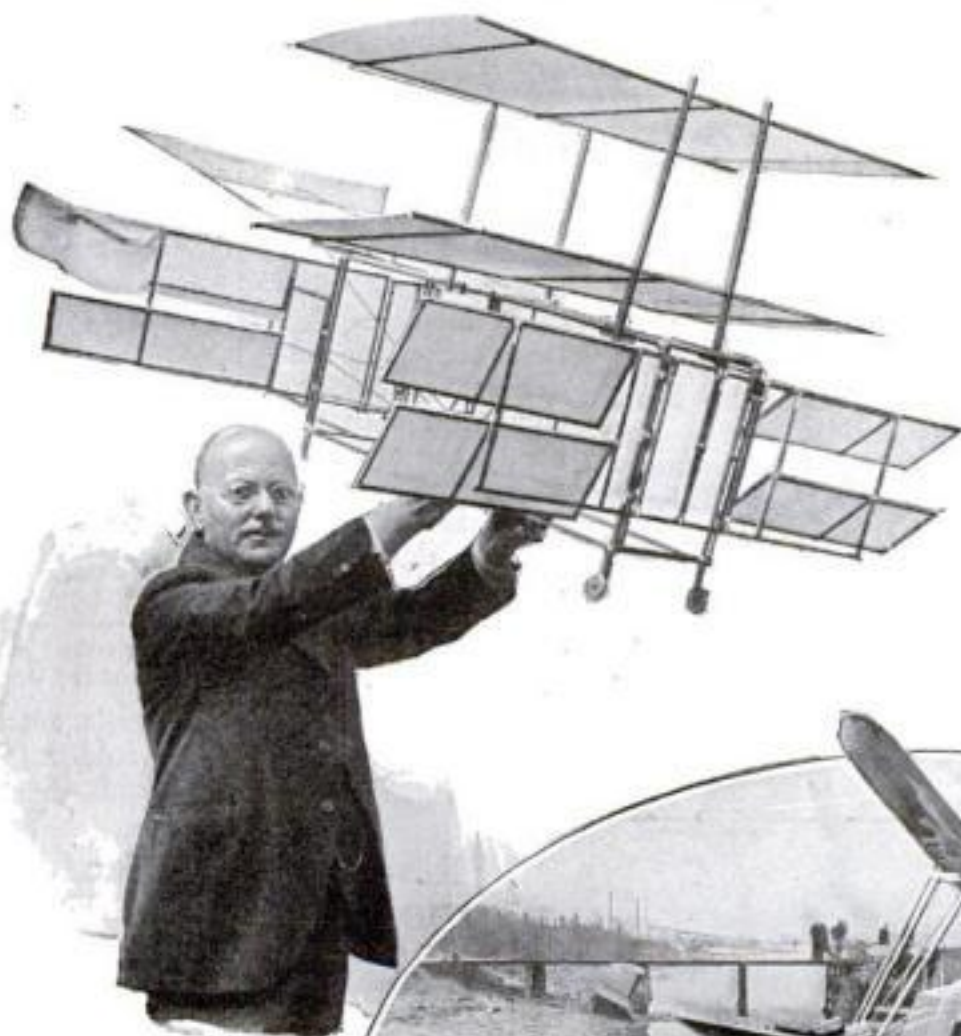
in the Sky, Dine in an Fly Your Own Flivver

A Sky Restaurant—the Last Word in Luxury

NOW you may eat as you fly. Observe the interior of the first aerial restaurant, operated between Paris and London. Twenty-two persons can be seated in this big flying dining-room, each guest occupying a small table. A fully equipped kitchen has been installed in the plane, and one can dine as luxuriously as though he were seated in his favorite Parisian restaurant. The machine, a giant biplane, was built for the Imperial Airways Company of London, operating a fleet of flying ships between the French and British capitals. Flights are made daily between Paris and London.



An idea of the proportions of the giant restaurant plane may be had by comparison with the men seen standing beside it



New Foot Plane

For years Lehman Weil of New York experimented on a foot-propelled plane. Here is the working model of his completed invention. Weil claims he has overcome the besetting difficulty of this type of machine—adequate propulsion. His plane is provided with two sets of vertical propellers that work like "feathering oars"



Driven by Air

Above is a model of a remarkable compressed-air-driven seaplane, designed by D. A. Paveley, a British inventor; he is seen pumping air into the machine. It flies for 60 seconds on 180 pounds of compressed air



Wrecked by Wind

The photograph at the left shows the wreckage of 17 of the U. S. Navy's newest seaplanes, recently tossed by a high gale against a sea wall at Sollers Point on Chesapeake Bay



An "Out of Order" Railway Crossing Signal

A RAILWAY crossing signal that fails to work is often more dangerous than none at all. By relying on an automatic signaling system, often the driver of a car will not "stop, look, and listen," as he might were no signal there.

A railroad on the Pacific coast, recognizing the danger of failure on the part of warning signals, has equipped its signals with a conspicuous red blade bearing the words "Out of Order." Ordinarily this auxiliary sign remains hidden behind a shield, but in the event of any electrical or mechanical failure of the device, it drops into position through gravity.

Musical Stenography Invented

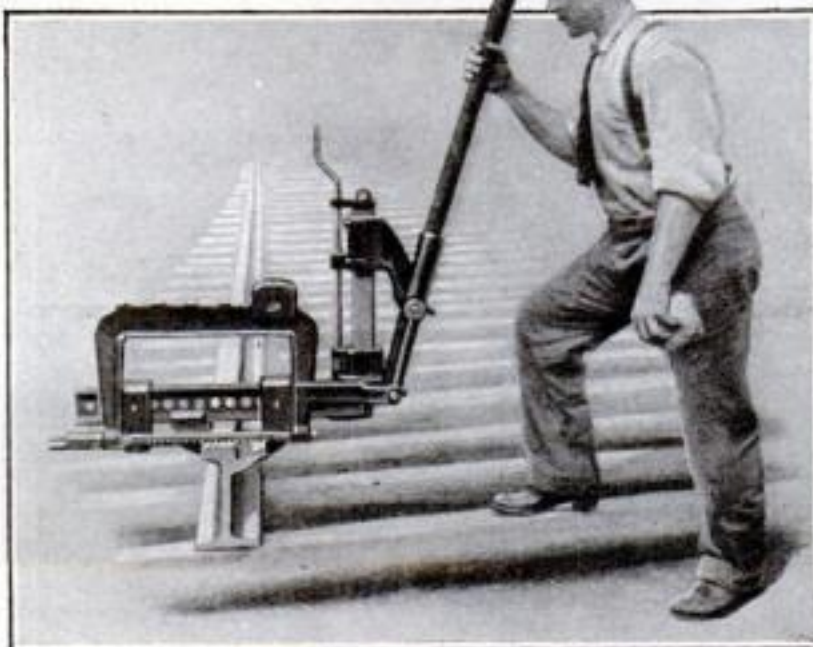
A SWISS, M. Henry Reymond, has devised a system of musical stenography that promises to solve a problem that for more than 100 years has perplexed musical thinkers.

The system would enable any one conversant with it to sit at a concert and note down the full orchestrated score.

One Man Can Operate This Rail Saw

RAILS can be cut right on the railway track with this new portable hacksaw. The ordinary hand frame used for this work requires two men, and blades often are broken in the work.

With this portable machine, weighing only 125 pounds, one man can cut through a rail, it is claimed, in from 30 to 45 minutes. The machine clamps on top of a rail or beam. It can be set at any desired point without removing ties and can be released and cleared from right of way in less than 10 seconds. The head of the machine can be swiveled so that the blade will cut any horizontal angle up to 45 degrees. On many difficult jobs it will become a useful labor saving device.



Cutting steel rails with a new portable hacksaw

Any Light Socket Runs This Saw

MANY a man will wax enthusiastic over the compact electric saw shown to the right. It has an eight-inch saw and a table that is about 14 by 22 inches. The three-quarter-horsepower motor can be run from an ordinary electric-light socket. If it is desired to cut other materials beside wood, carborundum wheels are used. An unusual feature of the machine is that it carries an exhaust fan and bag, so that all flying dirt and dust are eliminated.

THE United States is now the most important copper producing country in the world and is responsible for nearly two-thirds of industry's demands, which grow greater year by year.



Automatic Match Plugs into Any Electric-Light Circuit

AS ANY man will assure you, matches are the most elusive articles that complicate our every-day existence. Now an electric match has been invented, and, provided it is plugged into the light socket, is continually handy.

The manufacturers of this boon to smokers say it is the only lighter that will light and relight a pipe. It lights cigars and cigarettes just as easily. As it is made in an attractive style, it is suitable for any room in the house or for the auto, where it can be plugged into the electric system.

This man is using a new portable saw that has an exhaust fan and a bag to collect the sawdust



New Solder Cup Protects Men Doing Overhead Work

WORKMEN doing electrical work overhead frequently suffer from bad burns received from hot solder falling on their hands.

The tool illustrated here solders by the dipper method. Hot solder will not spill because the swiveled cup always remains vertical and all surplus solder that falls from the joint before setting is caught by it. Another advantage of this method of soldering joints, as compared with the use of the ordinary soldering iron or torch, is that there is less danger of burning the insulation from the wiring. This dipper can be heated over any kind of flame and its contents remain hot long enough to solder from 50 to 75 joints, it is said.



A new solder cup for overhead work

Reveal Ancient Plant Life

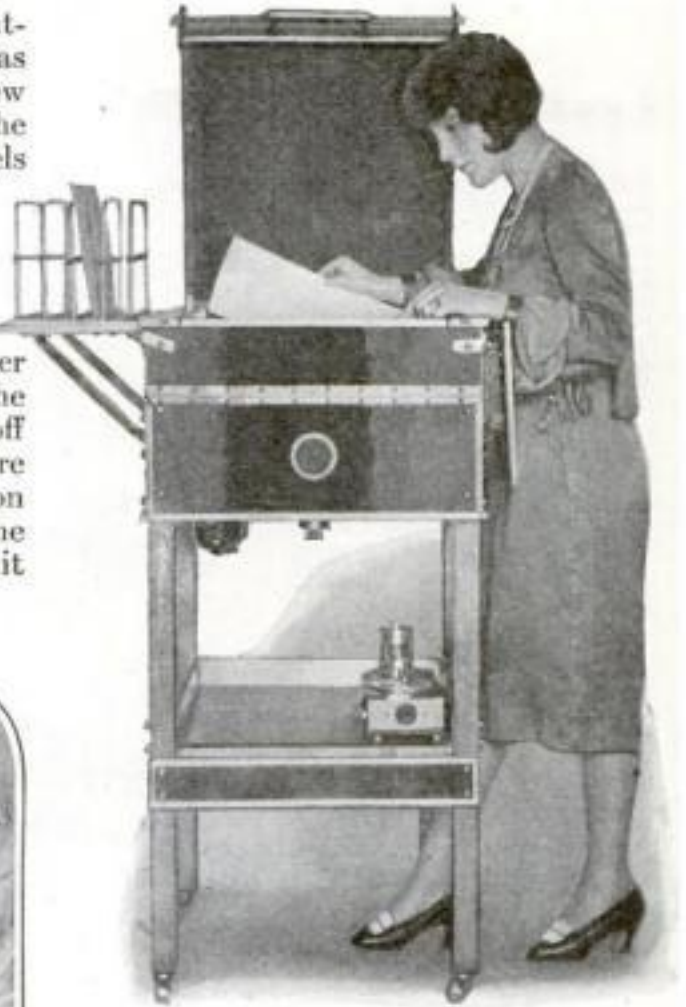
Coal balls, curious round lumps of stone formed around bits of fossil plants in the coal seams, afford valuable material for the study of the evolution of ancient plant life. The plant remains formed the nuclei or centers of deposition around which the stony material in solution in the water was laid down many ages ago.

Known in Europe since 1835, coal balls first were discovered in this country in 1922 in coal mines in Illinois, Iowa, Indiana, Kentucky, and Texas. More than 25 different species of fossil plants have been recognized in the American coal balls by geologists.

New Printing Machine for Photographers

SOMETHING absolutely new in printing apparatus for photographs has been invented by Commodore Matthew Steffins of Chicago. Attached to the machine is a cooling device that expels warm air from the printing chamber and admits cool air. This prevents the glass on which the films or plates are placed from getting hot, and permits of more prints being made.

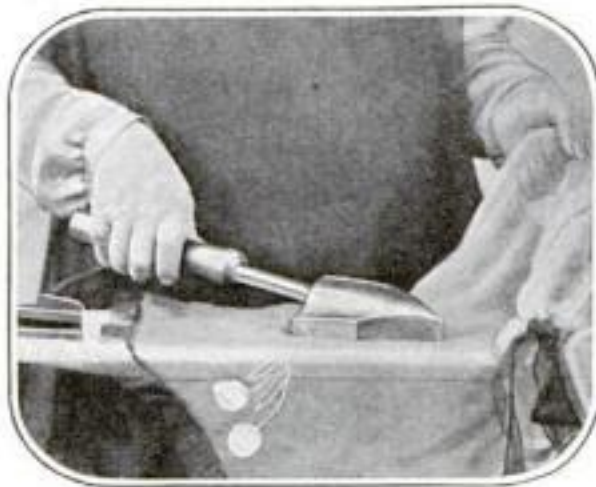
There are also a new timer and counter that save the operator from watching the developing, as the lights are turned off automatically when the proper exposure has been completed. These are shown on the lower shelf of the apparatus. The printing-frame is so well balanced that it requires no strength at all to operate it.



To Study Walking Mechanics

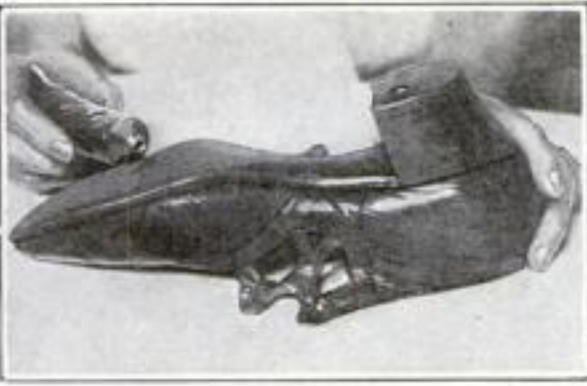
THE mechanics of walking is the latest subject to be investigated at Yale University. Scientists are attempting to learn how the walking bones, muscles, and tendons are coordinated in order to arrive at a uniform and accurate standard for foot examination.

Many applicants are rejected for the U. S. Army because they have low arches, although they never feel any discomfort. On the other hand, many with high arches break down later on account of foot trouble. The high-arch test, therefore, seems not altogether reliable.



Electric Iron for Awkward Corners and Frills

ALL laundresses know how difficult it is to get a flatiron into the corners of some garments. Their problem has been solved by a narrower, more pointed iron with a horizontal handle that easily slips into awkward shoulders, around delicate lace, and among fine gathers. Its makers claim that it slips in where the ordinary iron cannot go.



Leather Filler Mends Shoes without Cobbler's Aid

BLACKSMITHS have almost disappeared. Is it now the cobbler's turn? It would seem so, if mankind takes to mending its own shoes with a new leather filler that comes in a tube.

The filler is poured on the worn part of a shoe and shaped by the fingers to the correct form. Ten minutes' exposure to the air dries the liquid and it becomes an artificial leather that is said to be more lasting and weatherproof than natural leather. The filler is also useful for mending rubber goods.

New Device Opens Bottle and Catches the Cap

POP-BOTTLE caps have a way of being thrown on the floor.

Here is a new device, recently invented by John B. Frisone, that can be fastened to the wall and both opens the bottle and catches the cap. The caps fall into a drawer, which can be pulled out and emptied.

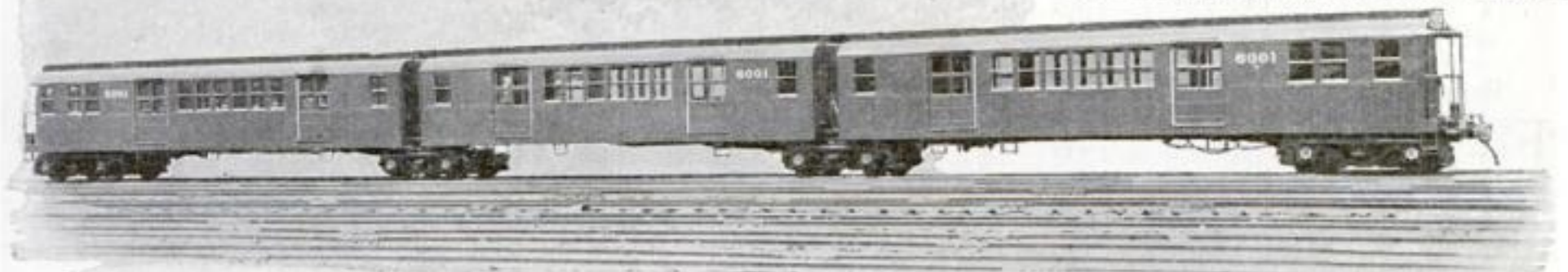
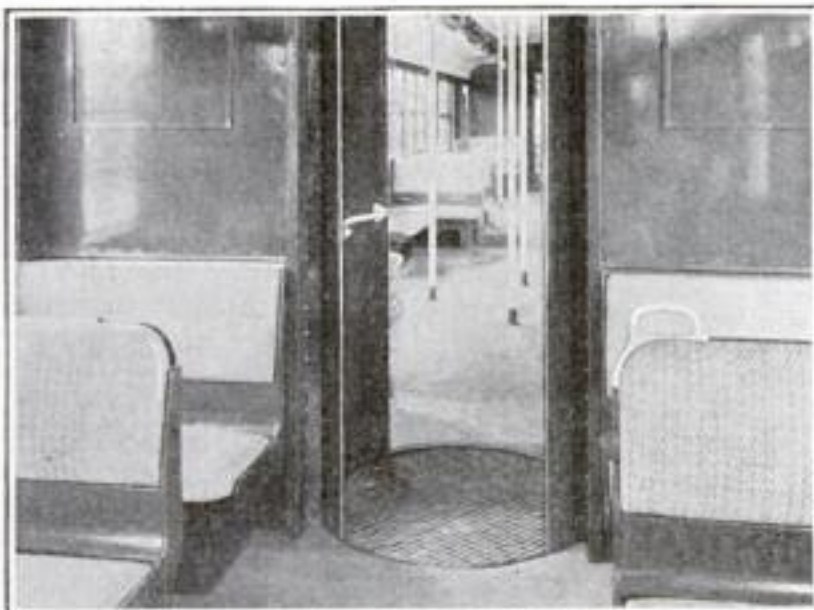


Latest Model in Safety Subway Cars

A NEW type of subway train, the latest model cars for rapid transit, was put in operation in New York City recently. Less noise, improved ease in riding, and more room for passengers are claimed for it by the manufacturers. In addition, danger of accident from falling from platform passageways is eliminated.

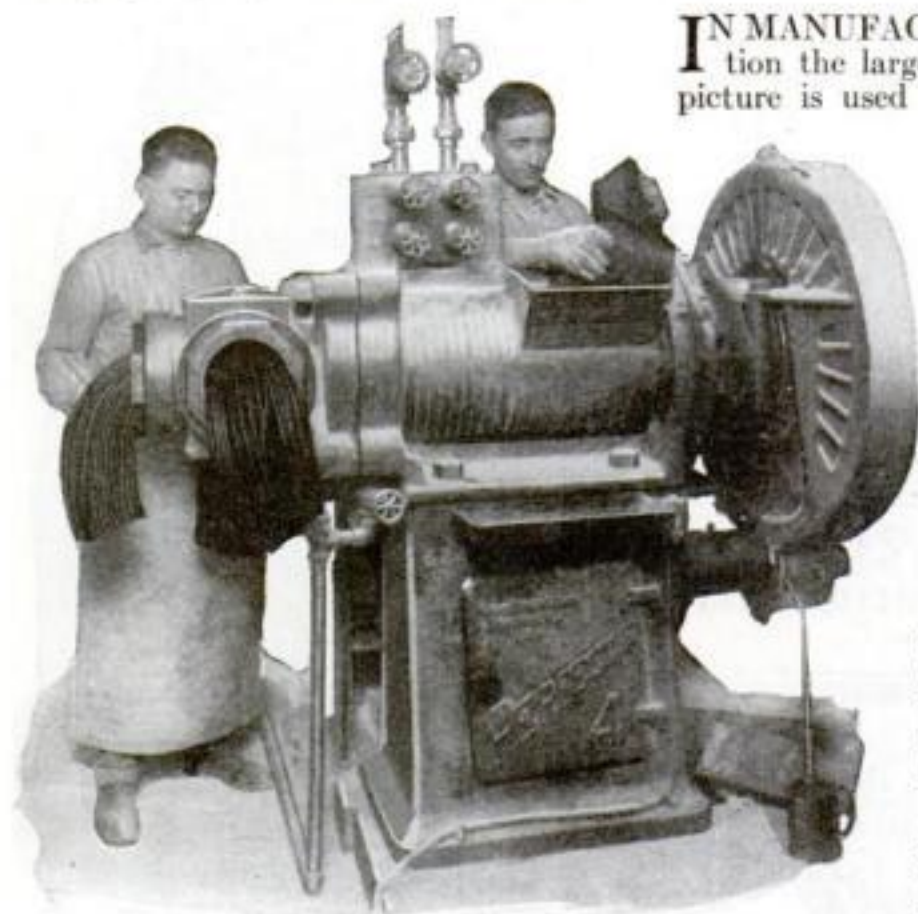
Instead of having single cars with two trucks each, the new train is made up of sections, each consisting of three cars mounted on four trucks, one at each end, and one at the point of contact between cars.

Getting rid of two trucks reduces the noise. The location of the trucks makes it possible to have inclosed doorless passageways between cars, so that passengers can go from one car to another, in case of overcrowding. Each car seats 160 passengers. Narrow seats accommodating only two passengers are used, so that the aisles are unusually wide. Six wide sliding doors on each side of the car permit interchange of passengers at stations. Four of the triplex cars make up a maximum length train, which costs nearly \$300,000. On the front car is a sign giving the route number.



Lower picture shows the triplex subway car. Notice how three sections are carried on four trucks. Upper photo shows interior of passageway

How Rubber Is Strained to Make Insulation



A machine that will strain all dirt, grit, bits of wood, metal, and other impurities out of insulation rubber compound

IN MANUFACTURING rubber insulation the large strainer shown in the picture is used to take out impurities.

The process is as follows: First, pure crude rubber is mixed with other ingredients in a large masticator. It then is run through a sheeting mill, after which it goes into the strainer. This machine is fitted with three very fine wire mesh screens, and, as the plastic rubber compound is forced through, all grit, dirt, bits of wood, metal, or other foreign bodies are left out.

The rubber compound then is put through a warming mill. After this final process it is ready to be applied immediately to the wire on tubing machines.



Narrow Tapered Nose Pliers— a New Combination Tool

A COMBINATION pliers recently has been designed not only for the ordinary uses about the house and yard, but also for more delicate work, such as radio construction. For the latter purpose the tool is made with a thin, tapering nose that makes it possible to reach otherwise inaccessible places. In addition, two sets of jaws are provided to grip such objects as nuts and bolts of various sizes.

The illustration shows the pliers in use, tightening the joint of a pair of pruning shears.

RUBBER long has been a mystery of chemistry. Instead of getting cooler as it expands with stretching, as all other known substances do, it gets hotter.

A Dutch scientist, J. R. Katz, has found a clue to the puzzle. By photographing thin sheets of rubber, using X-rays, he discovered that when rubber was stretched beyond twice its original length, it began to crystallize; the greater the stretch the more crystals. All substances changing from a formless into crystalline state give off heat, so now the mystery is solved.

Sanitary Bottle Has a Stopper that Fits like a Screw



A threaded-top stopper for bottle

ONE of the newest and most useful bottles has a thread top that accommodates a stopper made like a screw. It also is fitted with a washer, thus making the bottle airtight and suitable as a container for liquids that quickly evaporate if not stoppered securely. Its usefulness in the home or in commerce can be appreciated readily.

Roof Signs to Guide Fliers

FOLLOWING a suggestion of the Army Air Service, the Standard Oil Company of California recently ordered the names of towns and cities to be painted on the roofs of its warehouses, as a guide to aviators. The names will be painted in 12-foot letters, so that a pilot can ascertain his location at a glance.

To Get the Very Last Bit Out of a Paste Tube

TO SQUEEZE every bit out of the tube of tooth paste, shaving cream, or library paste, a new container for the tube has been designed by a Texas inventor. The tube is wound up from the bottom with a key that extends through a slot at the side. A further convenience is a special holder attached to the chute. The holder keeps the brush in a convenient position, making a handy kit.

The chief advantage claimed for the device is its economy, for, as every one knows, a certain amount of cream or paste always is lost in the ordinary tube.



Turning a handle squeezes tube dry

New Putter to Delight Golf Enthusiasts

MANY a golf enthusiast has longed for a putter that he can sight like a gun. Such a putter, said by its sponsor to be the most deadly of its species, has been invented by Eddie Nunn, a member of the Northern California Professional Golfers' Association. Recently Mr. Nunn has been displaying it on the links at Eugene, Ore. The club is made of myrtle wood and the head is a solid block about two inches wide, 1½ inches thick and three inches long. The back of the head is tapered to a

point, which is the dead center of the club, so that the user can sight with it.



A new golf putter that sights like a gun. Note the sight edge behind the club head, enabling the player to be accurate



Colored Typewriter Space Bar to Relieve Tired Eyes

YOU have heard, of course, that if your eyes become tired from close work, it rests them to look away in the distance, and psychologists have said that looking at certain colors is more restful than looking at others.

Denhol George, of Chesterfield, England, has applied this principle to a device he claims will relieve typists of eye strain. It is a bar enameled in nine colors, and clips over typewriter space bar. It can be attached or detached instantly.

The tints are arranged to form a strong contrast, and for typists accustomed to glance at the keyboard, the invention is claimed to minimize the ill effects of glare.

Oil Electric Car Breaks Non-Stop Records

WHAT is said to be the longest non-stop run was completed recently by a new oil electric car designed for the Canadian National Railways, when it completed a trip from Montreal to Vancouver, B. C., a distance of 2937 miles, in 67 hours. Not once during the trip did the engine of the car stop running. In addition, the trip was made in the fastest time on record for such a distance.

Railroad officials declared that the run was a striking demonstration of the possibilities of the oil electric car to meet bus competition and to solve branch line problems.

The average speed for the trip was 43½ miles an hour. In one part of the journey the car covered 22 miles in less than 22 minutes. It climbed one of the steepest grades in the Rockies at an average speed of 40 miles an hour.

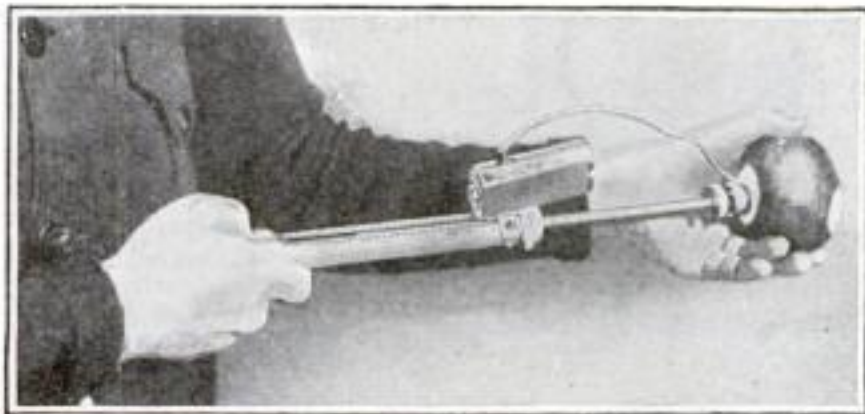
The power that drives the car is derived from an electric generator, which in turn is driven by an oil burning engine, said to be the lightest of its kind. The car accommodates 57 passengers.

Gage Determines the Ripeness of an Apple

MRS. HOUSEWIFE long has known that she could test the ripeness of an apple by pressing the skin with her

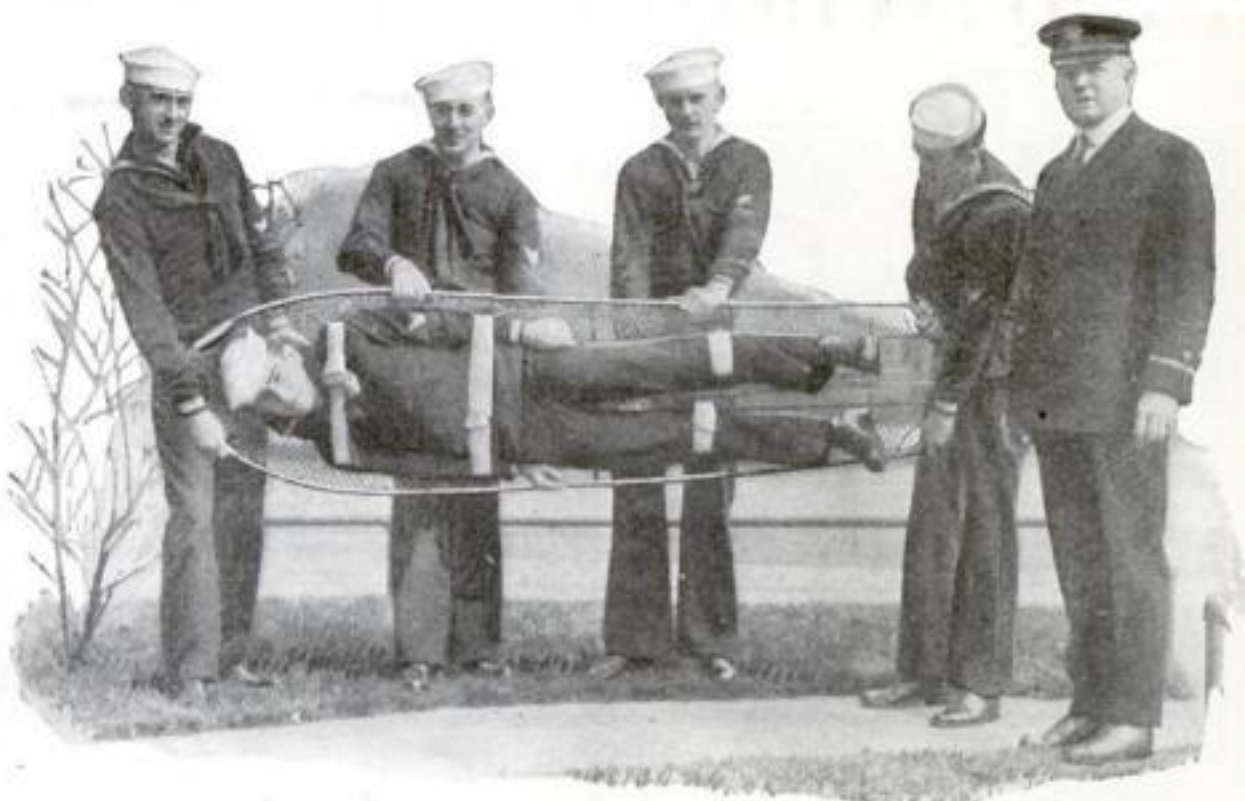
thumb. Now Uncle Sam has taken over her idea and the Department of Agriculture has devised a scientific substitute for the thumb as used for this purpose.

It looks somewhat like an automobile tire pressure gage. A plunger penetrates the flesh of an apple or other fruit, while the maximum pressure required to penetrate to a given distance is recorded. This record tells the ripeness or greenness of the fruit. The outfit is said to be useful also for growers and dealers.



This tester tells how ripe an apple or other fruit is by using a gage in place of the thumb, and gives accurate results

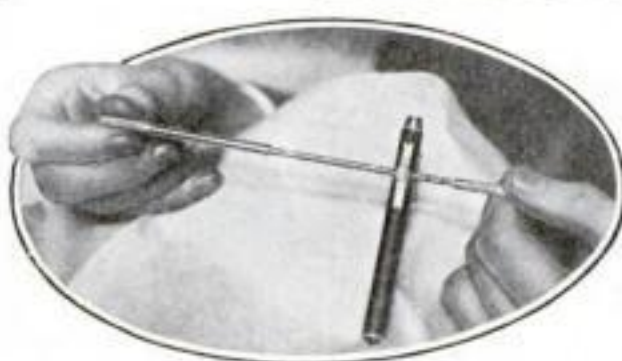
No Patient Can Fall Out of This Stretcher



A REAL safety-first stretcher is this new one devised for use in the U. S. Navy and demonstrated recently at the Navy Day celebration at the Charlestown Navy Yard, Mass. The stretcher is shaped like the half of a mummy case, and the patient cannot possibly fall out of it, no matter how great the

bumping of the ambulance or how uneven the steps of the carriers.

A net is stretched over a light wire frame to which straps are attached. These fasten about the patient's shoulders, arms, and legs and keep him in position. Slits in the netting supply places for hand grips for the bearers.



A Device that Whirls the Doctor's Thermometer

SHAKE, shake, away it flies, and there is another broken thermometer. It was time that some one invented a way to handle this delicate instrument.

The ordinary way is to shake the mercury down in the surgeon's or physician's thermometer. Now comes an inventor with a device for whirling the thermometer in place of shaking it. The instrument is attached to a screw-threaded shaft and when the ends of the shaft are pulled, the thermometer spins around it.

The Blind to Read and "See" by Sound Alphabet

TEACHING the blind to read by means of different shades of sound is a new and remarkable method invented by Professor Rosing, an oculist of Leningrad, Russia. Every letter of the alphabet will be expressed by a different sound. So far, sounds have been contrived for 18 letters of the alphabet.

The sounds are used, too, to see objects. Experiments showed, it is claimed, that children using the sound apparatus were able to define many articles in a room and recognize persons who were passing.

Every Time You Save a Coin You Get Some Candy

SOME fun - spoiling person is going to step forward and say: "It's just spoiling the children. They should save because they want to—not for a reward."

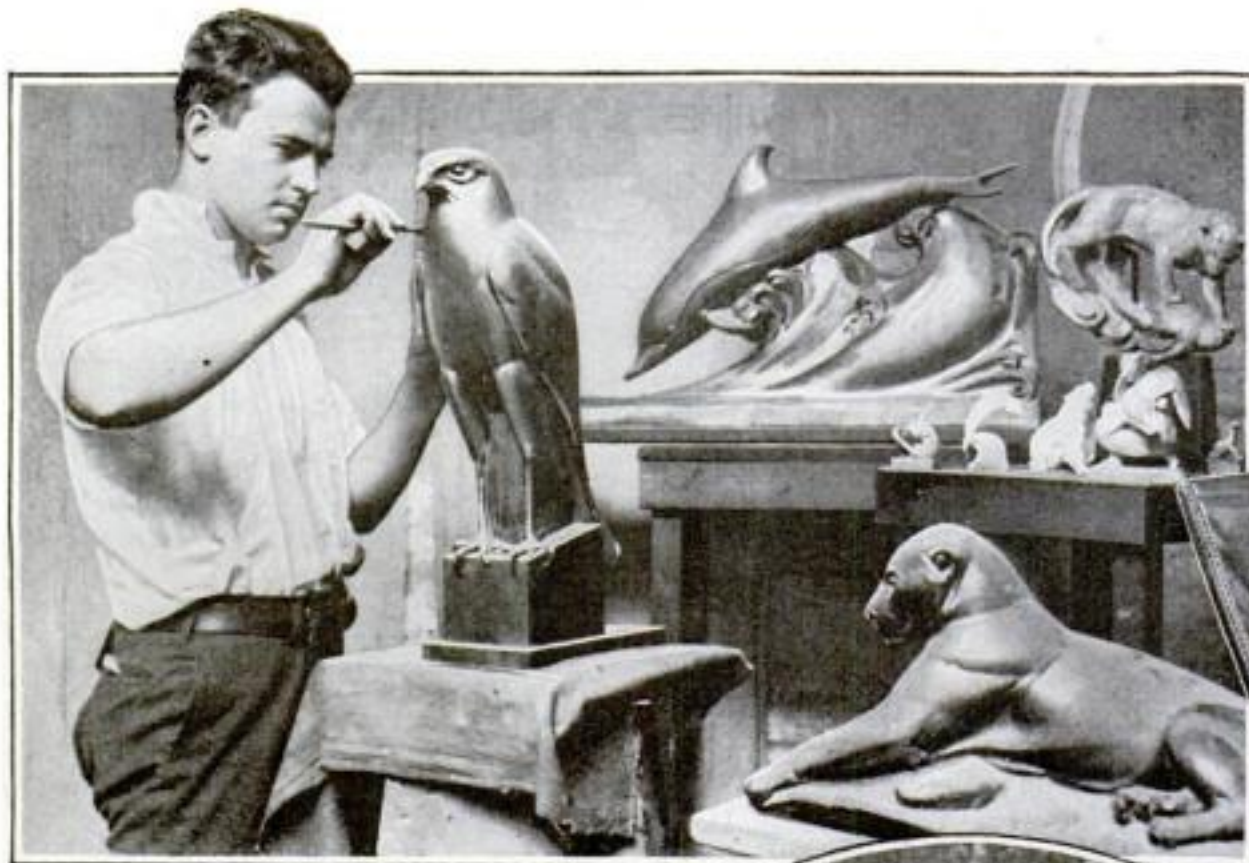
But stop to consider the matter. If you were a small boy or girl, how would you like to have a bank like a candy slot machine?

Every time you put in a nickel or dime, out would come a piece of candy. Wouldn't it make you more enthusiastic about saving than watching your shiny nickel being swallowed by a bank that gives nothing in return? The bank in our illustration does exactly this. The inventor is an Englishman.



A novel candy slot-machine savings bank

Men Who Excel at Odd Handicrafts

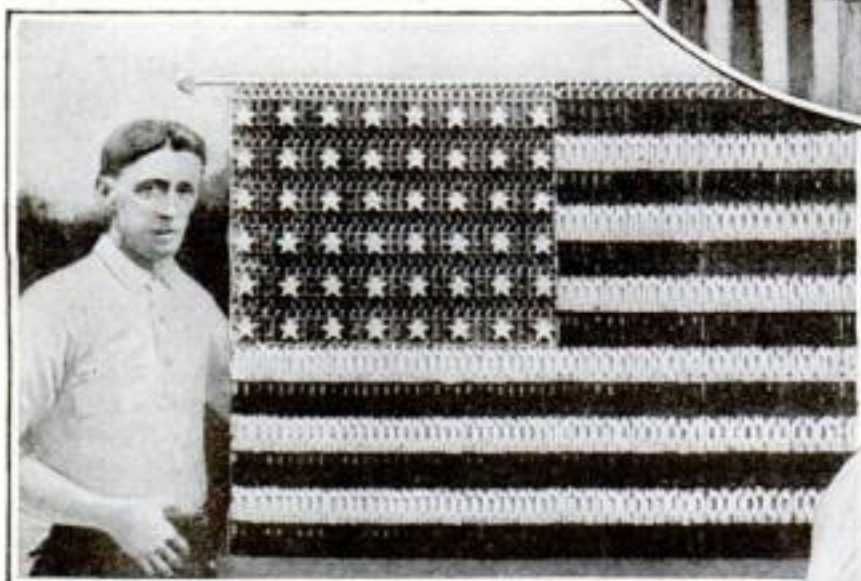


A Sculptor of Animals

Albert T. Stewart, of New York City, specializes in animal sculpture. He is shown above working on one of his latest pieces. The "Dolphins," in the background, was sculptured by Mr. Stewart for the Seamen's Institute as a memorial to the men of the Merchant Marine who fell during the Great War.

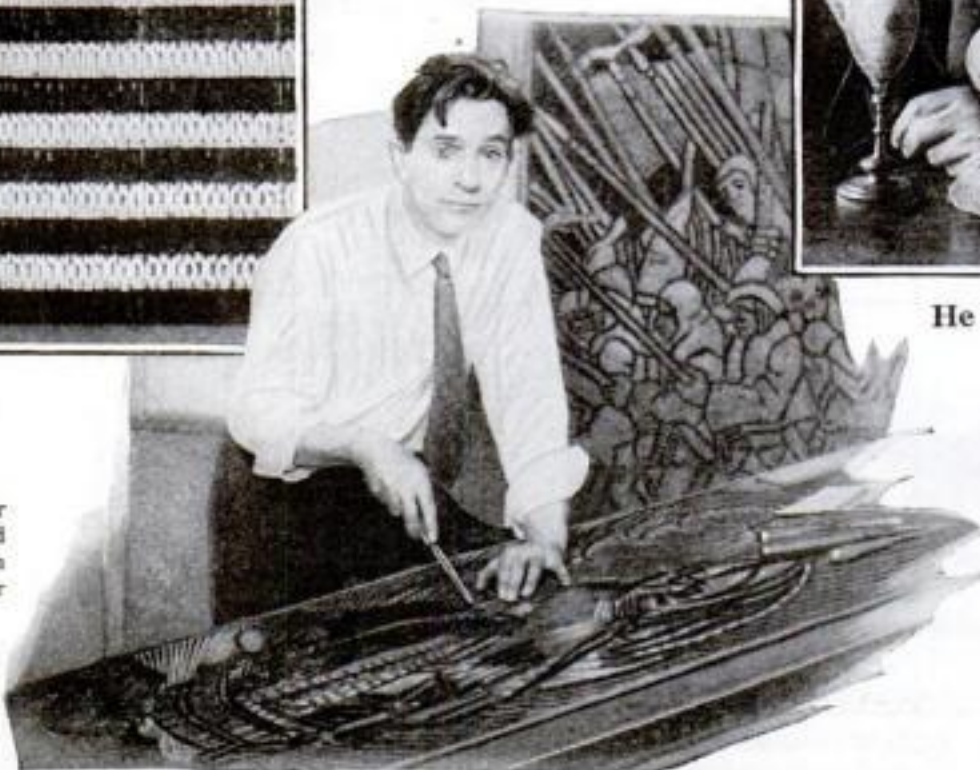
Stars and Stripes Made of Wooden Links

After several years of tedious effort, and with a pocket knife as his only tool, Clyde Tansey, of Tipton, Ind., has finished a replica of the Stars and Stripes carved in poplar. All the links are colored and enameled and some of them are carved in a most intricate design. This unique flag is reversible.



Block Printing Textiles Is This Man's Specialty

At a recent exhibit of the Arts and Crafts Center in New York City, Gilbert Fletcher received much commendation for his block printing on textiles. He uses a separate block for each color and some of his designs are so large that he must cut his block and print in sections. In spite of this handicap, Mr. Fletcher's designs show no joints. He is shown at right carving out a design on linoleum.



Policeman an Artist at Embroidery

Patrolman Henry M. Johnson, of the Boston Police Department, is one of the best men on the force, ever ready to chase a desperate bandit or a wily burglar. His special claim to fame, however, is the embroidery that he does in his spare time. He is pictured below holding one of his recent creations.



War Vets Excel in Model Shipbuilding

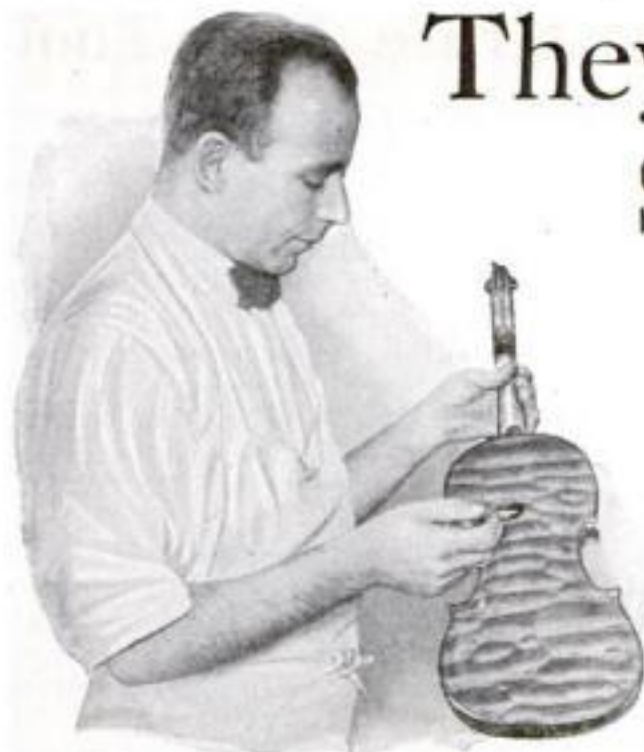
Shown at the left with some of their unusual ship models are William (left) and John Allen of Prides Crossing, Mass. After their return from the war, they took up building models of old time merchantmen and other ships, and they now are considered to be at the top of their profession.



He Embroiders Eggshells at \$1000 Apiece

N. K. de Scherviller, of Rouen, France, embroiders eggshells. From 600 to 2000 holes are made in each shell and all knots are made on the inside of the shell. Sometimes two dozen eggs are used before one can be made perfectly. The egg on the right took 18 months to embroider.

They Do the Unusual—Some Strange Occupations



Waiter and Artist

During the day Mike Gozzo of Los Angeles can be seen in the ordinary avocation of an obliging waiter. At night he discards his waiter's uniform and settles down to the real business of his life's ambition—the making of violins, as shown above. Cash is short, but art finds a way

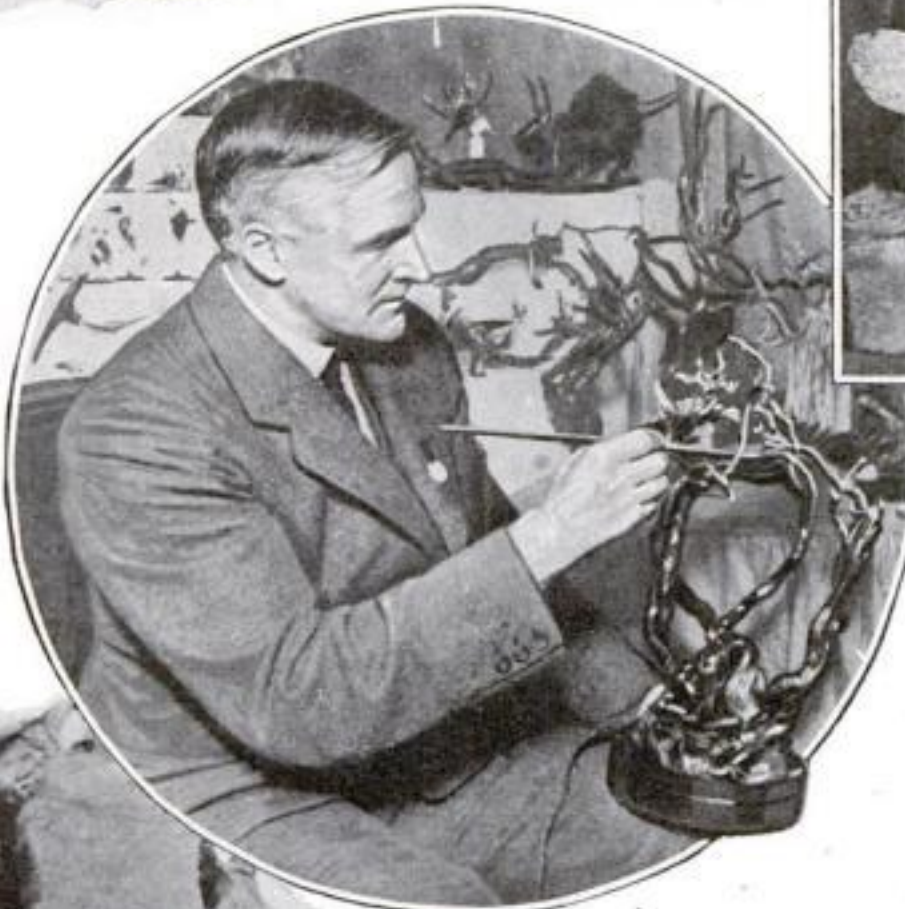
Only Painted Roots

Below is a picture of Ivor Innes, an English artist, who has drawn the attention of all London to his heather-root articles, which he exhibited at a recent show of the Arts and Crafts. While on a vacation in the Cornish hills he conceived the idea of taking living heather roots and forming them into many shapes. These he paints in fantastic colors. The roots still grow in spite of their twined shapes



He Sets Prehistoric Bones

The Dean of the Maryland Academy of Sciences, Dr. Francis C. Nicholas, is here shown at the task of assembling the bones of a shark said to be 300,000 years old. His job is to sort the bones of prehistoric animals



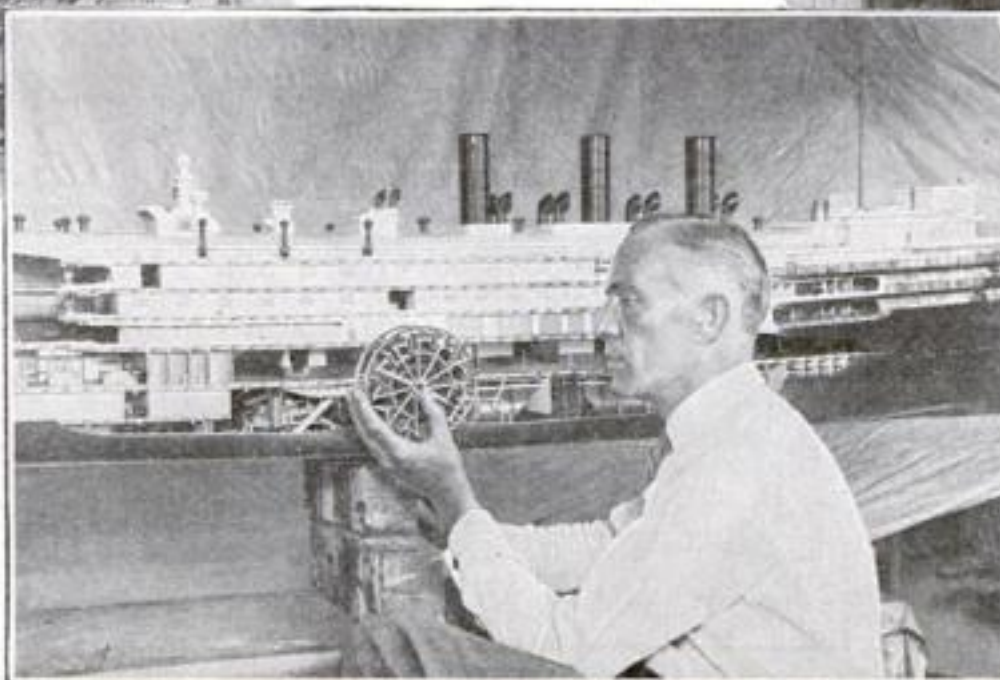
\$10,000 Ship Model

Below: A remarkable model of the S.S. *Greater Detroit* and its builder, Horace E. Boucher of New York City, who made it for the Detroit and Cleveland Navigation Company. Every detail of the completed ship down to carpets and interior furnishings, is shown in the model, which cost \$10,000. It took eight months to build the boat



The Corn-Husk King

Corn husks have made a fortune for this man. He is W. E. Blain of Wichita, Kan., known as the "corn-husk king." For five years Mr. Blain has been buying corn husks and he claims he has had an income larger than the average successful banker. The husks are sent to various parts of the country, where they are used to wrap up hot tamales



"Some Bricklayer!"

An Indian athlete, James Garfield Brown, is said to be the world's champion bricklayer. He can lay two bricks a second. On a Kansas City highway job he recently laid 73,815 bricks in eight and one-half hours. The laid bricks covered a distance of a quarter of a mile



A Motor-Coach Workbench to Demonstrate New Tools



Above, interior of traveling workroom. To the right, gasoline generator to operate tools. Below, exterior of the novel car



AN EASTERN hardware company is sending a meeting room on wheels from town to town, using it as a demonstrating workshop to teach salesmen the use of new tools.

The exterior of the coach resembles an observation car, having a brass rail at the rear, a short awning canopy, and an illuminated drum light. The interior is fitted with eight large wicker chairs, like those used in railway observation cars. All the additional conveniences of luxurious travel have been added. A complete self contained gasoline generator set, mounted at one side of the driver's seat, supplies current for the electrically driven tools.

Back of the rear axle the frame has been dropped about 14 inches to provide a compartment in which the demonstrator will have full head room. Across the rear end of this is a buffet to hold the smaller tools. Larger tools, such as electric drills and grinders, are bolted to the top of the cabinet and to a workbench.

A large trunk built on the rear of the coach carries store and window display material. Three men travel with the coach over an established itinerary.

ACCORDING to the measurements of a German scientist, a soap bubble is only one 150-millionth of an inch thick in spots. Thin gold foil is about one 250-thousandth of an inch.

Fireproof Gas Tank for Safe Transportation

AN ALL-STEEL fireproof gasoline tank with a capacity of 1500 gallons, designed for safe transportation of gasoline on motor trucks through city streets, recently was tested with satisfactory results by New York City fire officials. The tank was placed in a vacant lot and filled with 1250 gallons of gasoline. Beneath it was built a fire of excelsior saturated with gasoline. The terrific heat drove spectators back for more than a block.

The tank has six compartments. Before any gasoline can be withdrawn, a fire door at the rear that shields the emptying apparatus must be unlocked. This cannot be done while the motor truck is running. In case of threatening fire, the door automatically closes, at the same time shutting off the flow of gasoline.

Tanks of this design are to be used by a New York delivery company, it has been announced. The inventors are J. A. Kenny and Frank A. Holby.

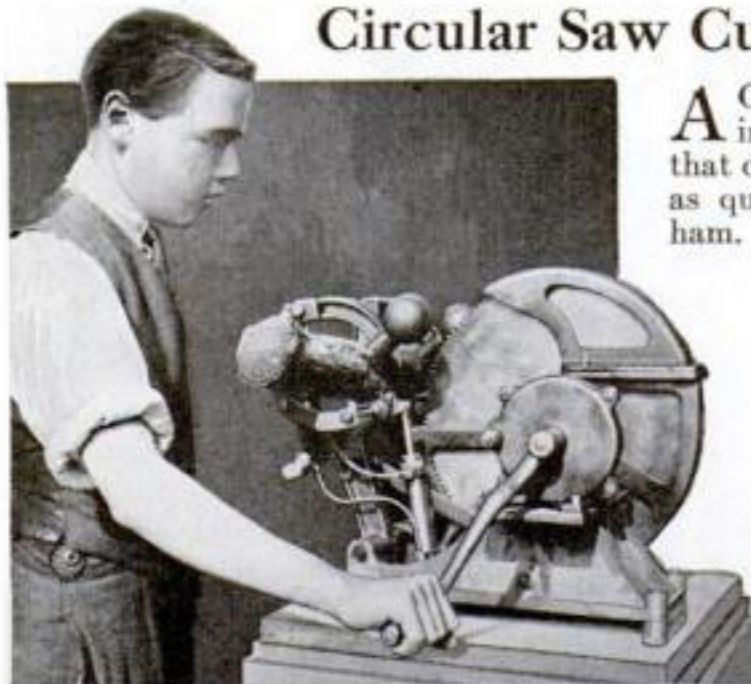
Portable Scraper Outfit that Reduces Cost and Labor

REPLACING four men and teams, a new portable scraper outfit, it is claimed, will excavate and carry loose materials over short distances in quantities up to 400 yards a day.

The outfit is designed for contractors, county and township road commissioners who use local pits of gravel in road construction. The scraper can be used, too, in digging cellars, making highway cuts, and storing crushed stone.

A double drum hoist is driven by a gasoline engine or electric motor mounted on it, with direct connection. The drum hoist also is arranged for belt drive from a tractor, motor, or engine.

Circular Saw Cuts Logs like Ham



The novel Parisian circular saw that cuts logs into any lengths. It is operated by hand with comparative ease

A CARPENTER of Paris recently has invented a high geared circular saw that cuts up logs into small pieces almost as quickly as the butcher slices boiled ham. It is geared on the same principle as a carborundum wheel and can be used in any woodshed or small shop where a regular power saw would be too expensive. It is worked by hand.

IN AN article on page 51 of our December issue a miniature town constructed by school children was credited to Springfield, Ill., instead of Springfield, Mo. This was an error on the part of a contributor. POPULAR SCIENCE MONTHLY is very glad to correct the mistake.



Using portable scraper equipped with hoist unit to dig gravel for road construction



A Concrete Column to Protect Filling-Station Pipes

THE proprietor of an oil station near Sacramento, Calif., has erected a concrete column in which he has embedded the compressed air pipes, water pipes, and drinking fountain. This attractive device prevents motor cars from striking and damaging these facilities. A basin in the top of the column drains the water from the drinking fountain.

He Claims to Make Steel Direct from Crude Ore

A NEW way of making steel and workable iron direct from the crude ore, was developed not long since by Henning Flodin of Stockholm, Sweden, who described his process to steel manufacturers and scientists recently at Birmingham, England. He claims it was well tested.

He used Swedish hematite ore, English coal, and Swedish charcoal in furnaces taking from 250 to 300 kilowatts of electrical power. The process is continuous and feeding needs to be interrupted only when a batch is poured. The phosphorus and sulphur content of the product is almost negligible, it is claimed, and carbon is as low as two-hundredths of one per cent. The process is said to be particularly well adapted to the making of high grade tool steels.

A Combination Truck for All Street Jobs

THE street-cleaning department of Berlin, Germany, has a new truck that is equipped to meet all street-cleaning problems. In summer it is a street sweeper and a sprinkler. In the winter

it is employed as a snowplow. In addition to these purposes, not the least of its advantages is the fact that there is enough pressure back of the water to use the truck as an extinguisher in case of fire.

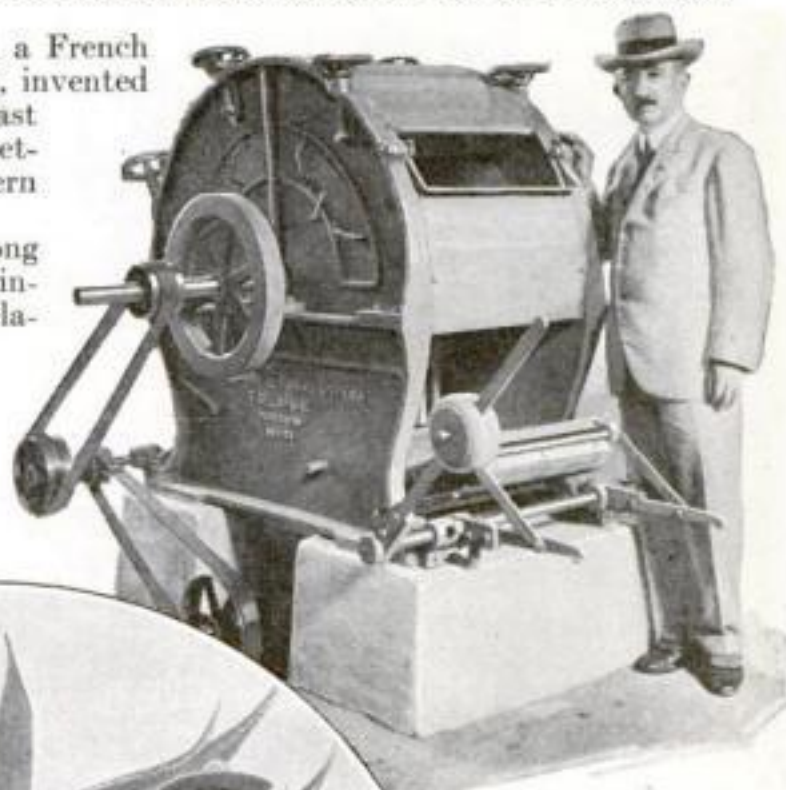


New German truck sweeps and sprinkles streets, plows through snow, and puts out fires

Century Plant Yields Alcohol and Fodder

RECENTLY Elie Delafond, a French engineer living in Mexico, invented a machine that extracts the last ounce of use from the agave, better known to more northern climes as the century plant.

Fibers of the agave leaves long have been used for various industrial purposes, but M. Delafond's machine separates the fibers of the trunk of the plant, a much more difficult process. At the same time the new machine, which is of the centrifugal type, squeezes



The above machine separates fibers from trunks of the century plant and from them extracts the pulp and juice. Alcohol is obtained from the juice, and the pulp is used for fodder. To the left, a huge century plant, luxuriant in old Mexico

and presses the juice from the pulp. After distillation the juice is concentrated to extract the salts, leaving an alcohol that is used in autos. The squeezed-out pulp is fed to cattle.

New Motor Truck Engine

A NEW type of motor-truck engine recently has been developed by the U. S. Army. The engine is said to deliver an increase of 28 per cent in power with a decrease of 20 per cent in fuel consumption. This engine uses the new ethyl gasoline for fuel.

Paper-Mill Ships Are Fitted with Ice-Cutting Prows

FROM the great paper mills of Newfoundland newsprint is carried to all parts of the world. As the island is ice-bound for the greater part of the year, ships must cut their way through the ice to get out into the open sea. One of the



Observe the ice-cutting prow of the ship, which saws as it goes

foremost paper companies recently has put into commission two ships fitted with a new type of prow that from the waterline down is edged with a kind of saw that cuts the ice as it goes.

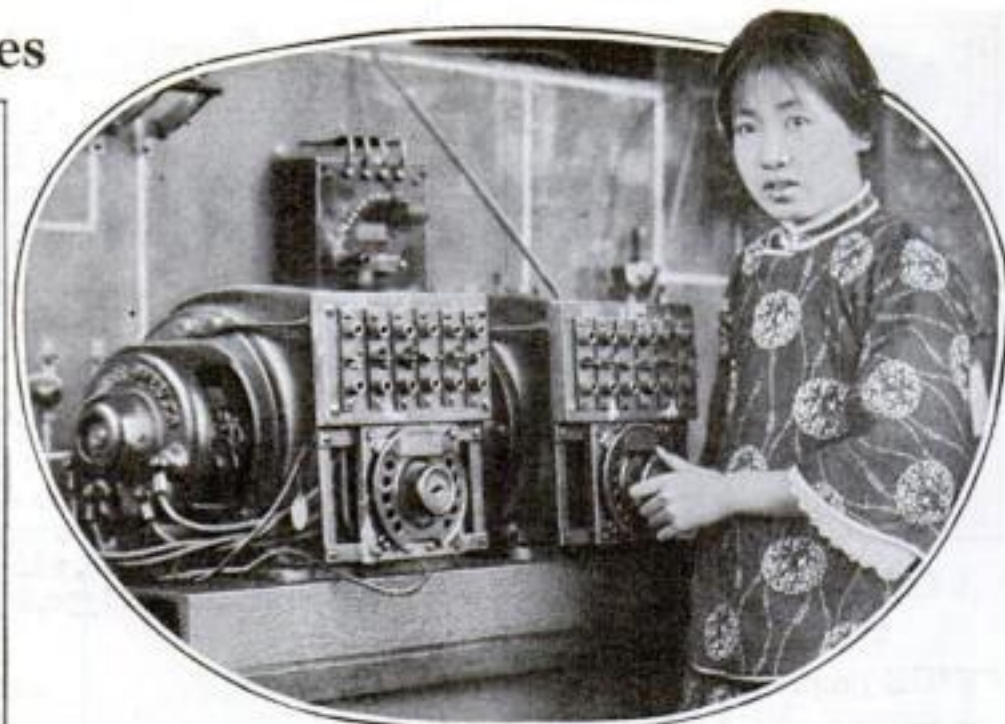
ON PAGE 21 of our November issue it was stated that the brigantine *Carnegie*, operated by the Carnegie Institution in investigating terrestrial magnetism, would sail within a few weeks. Through failure to transfer a qualifying phrase from a corrected proof, the article did not make clear that no definite date had been set for the *Carnegie's* departure. As this issue goes to press, the Carnegie Institution has not yet made any announcement of the sailing.

Teaches Children to Handle Snakes



BEING curator of a museum is a pretty big job in itself, but Mrs. Grace Olive Wiley, curator of the Minneapolis Museum, has added another job to her list. She teaches children the right way to handle snakes without being bitten, and thus to overcome a fear that is perhaps one of the most deeply rooted in the psychology of human beings.

Mrs. Wiley has given much study to the habits and moods of snakes and other reptiles, and she believes that her training will avert many accidents among the children of her city.



This Chinese Wife Smashes Many Ancient Precedents

AT LEAST there is one Chinese who believes that woman should have a place outside the home as well as in. Mr. Kuan Tung, studying for a Bachelor of Science degree at the Massachusetts Institute of Technology, decided that he would like his wife to study there, too. Though she already has the degree of Bachelor of Science from the National Technical School of China, she is taking up an electrical engineering course with her husband.



Amateur Actress Makes Up with an Air Brush

PATSY CHAPMAN of St. Paul, Minn., has a new idea for applying face paints. She uses an air brush, the liquid colors being blown on her face.

One day she observed a painter blowing paints on an automobile. He explained that the paint went on smoother and looked better than if he had used a brush.

Miss Chapman determined to try it in the art of theatrical make-up. A friend agreed to manipulate the brush. The method is said to result in a more delicate blending of tints.

Young Woman Chemist Is First in New Biological Field

IN THE human body there is an "electric motor," called an "enzyme," that can speed up bodily reactions necessary to life. There are enzymes, too, in plants and other animals. Scientists know what they can do, but not what they are.

A young research chemist, Miss Grace McGuire, is at work in the Harriman Research Laboratory in New York City, trying to solve the mystery of these agents that can hurry life processes. Miss McGuire is the first to undertake this field of biological chemistry. Her work already has drawn the attention of other scientists, and they are awaiting her findings with interest.

How Much Do YOU Know about Science?

HERE is a capital opportunity for you to test your knowledge of the world in which we live. How many of the 12 questions can you answer offhand?

Many of the questions have to do with every-day phenomena. A well informed person always wants to know the reason for natural facts. Test your knowledge first, then turn to page 151 to verify your answers.

1. Are modern men less healthy than prehistoric men?
2. How does a thermometer work?
3. Why is quicksilver used in thermometers?
4. How do we know that men do not live on the moon?
5. Why does a blister form when the skin is burned?
6. Why is there more fog in cities than in the country?
7. How is milk made into condensed milk?
8. Why do savages listen with their ears to the ground?
9. Is it true that the century plant blooms only once every 100 years?
10. Why does cream rise to the top of milk?
11. How much salt is there in the sea?
12. Why do whales have to come to the surface of the ocean to breathe?

A Boon for Mothers—A Baby Carriage Garage

A GARAGE for baby carriages? Why hadn't some one thought of this necessity before?

A new tenement in New York City has the first baby carriage garage. It is made of galvanized iron, is fire-proof, and has a separate compartment with door and lock for each carriage. Some of the mother chauffeurs are shown in the picture.



New York mothers taking their "cars" from the novel community garage



Motorists Have Narrow Escape as Car Hangs by Wheels

ONE day, recently, without warning, Mr. and Mrs. S. P. Guile of Minneapolis, Minn., found themselves the central figures of a hair-raising thriller.

Crossing a bridge over the Hennepin Canal at Colona, Ill., their car collided with a truck. Both skidded to the edge of the bridge. The Guiles' car crashed through the railing and began to topple. It seemed that in a moment it would be a mass of wreckage in the ravine 25 feet below.

But suddenly, movement stopped. The rear wheels caught on the bridge railing and a front wheel braced against the bridge abutment. It was an hour before the car door could be opened and the Guiles released. An hour of waiting, expecting every moment to fall to death, provides enough suspense to last any one a lifetime.

THE number of passengers carried by French airplanes in 1924 was more than 16,000, and the quantity of merchandise carried about $2\frac{1}{2}$ million pounds, the latest figures show.

Chinese Wheelbarrow Is Poor Man's Taxi

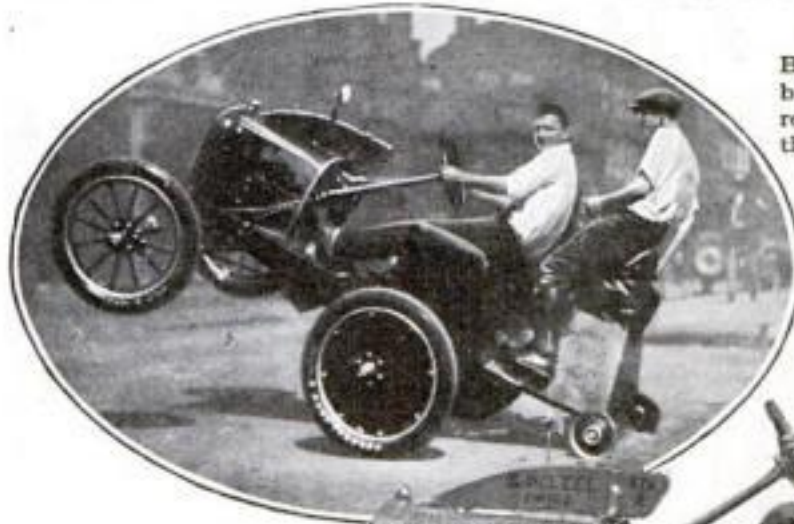
A CHINESE wheelbarrow differs from the type we are accustomed to in that the large wheel projects through the center of the body, which with its wire guard forms two "compartments" to the vehicle. It is used in China as a sort of poor man's taxi, not alone in the factory districts, but also in the

country, where it is suited to the roads, which in many instances are nothing but well worn paths.

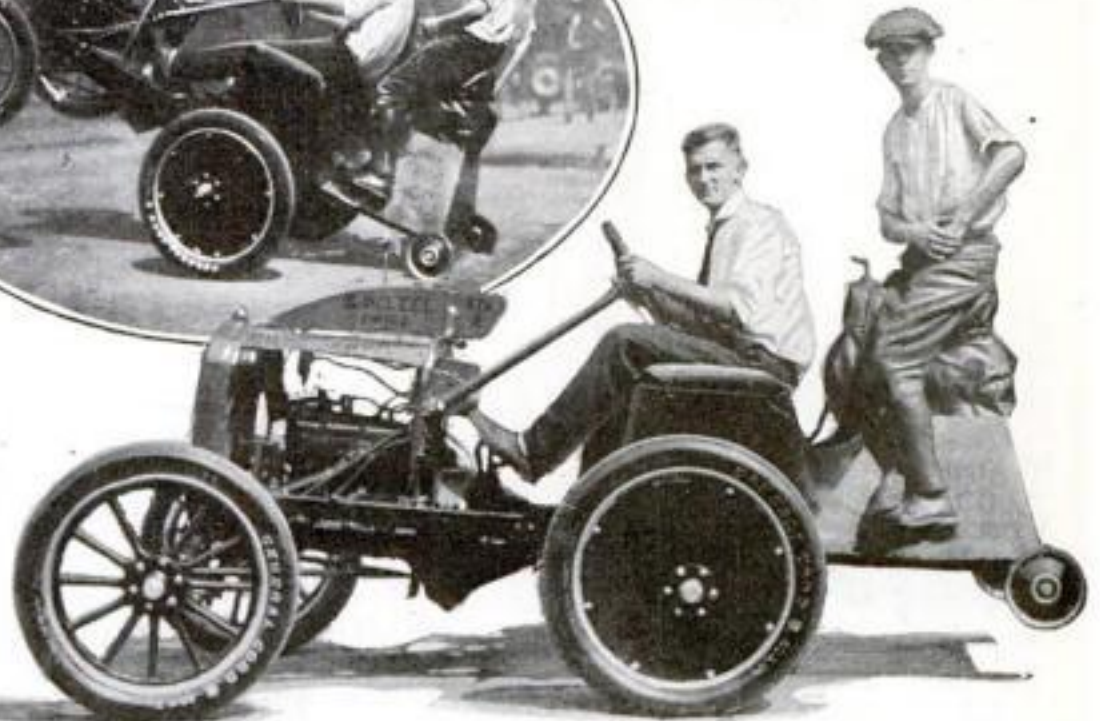


When East and West meet—Motorcyclist surveys with much amusement a primitive Chinese wheelbarrow, which is used by workmen as a carriage

Auto Imitates a Fearsome Bucking Broncho



Above: "Pawing the air" is one of the bucking auto's many funny tricks



Below: A. Pelzel, inventor of the bucking auto, is seated at the wheel, ready to put an intrepid passenger through the trick car's many "paces"

THOUGH it does not hail from the Western plains, this auto has all the bad tricks of the unbroken pony. It bucks, rears, plunges, but, unlike its wild prototype, only at the driver's will. The trick car was built by Alfred Pelzel of Cincinnati, Ohio. As illustrated above, the kicking broncho automobile carries a passenger in addition to a driver, and

it is said that Mr. Pelzel finds no difficulty in filling the rear seat, for where is there an American boy or man who does not fancy himself as a potential cowboy of the great open spaces?

IN AUCKLAND, N. Z., it is a rule that street cars may not carry more passengers than can be seated.

Midget Runs 52 Miles on a Gallon of Gas

A BABY automobile, no longer than a man is high, pulled into Washington, D. C., recently and sailed up to the Capitol, the end of a transcontinental tour from San Francisco. Its driver, Gus Petzel of Alameda, Calif., was also the designer of the sturdy little machine that scooted over mountains and deserts that bother cars five times its size.

It has a four-cylinder, air-cooled motor, nine speeds, electric lights and starter, and is equipped with airplane tires. The wheel base measures 60 inches and the car weighs only 560 pounds. It can make a speed of 80 miles an hour on the track, it is claimed, and 65 on the road. After reaching Washington, the designer demonstrated that his unique little car could travel 52 miles on a gallon of gasoline.

Subway Garages for Paris

PLANS for a system of underground garages and subterranean streets as a means of relieving traffic congestion in Paris, France, were announced recently by M. Morain, the Prefect of Police. The underground thoroughfare, it is said, will be built simultaneously with a proposed new subway line.

For further relief of surface traffic congestion, moving pavements have been suggested. The first of these pavements, according to the plan, probably would be elevated and would run along the boulevards having the heaviest traffic.

Household Tools and

If Studied Scientifically, Housework Problems

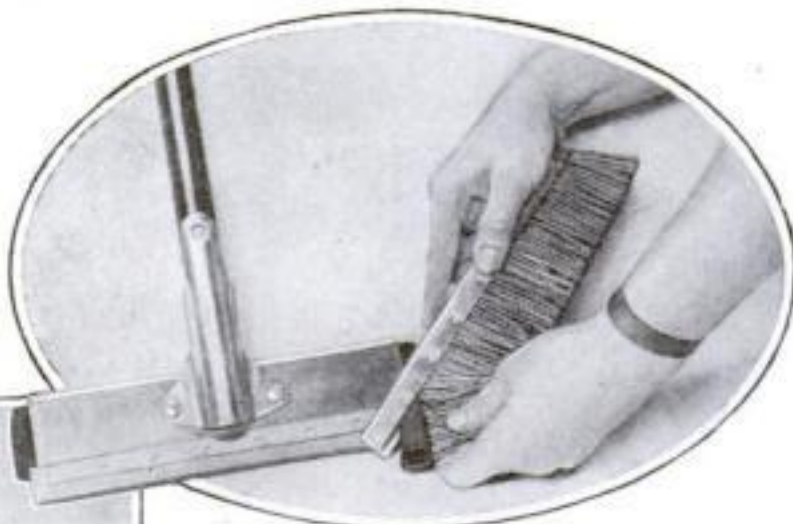


Broiler for Use on Top of Stove

For the woman who must cook on a small gas stove, for the camper, or for days when you do not want to use the oven, the broiler illustrated above will be found a great convenience for cooking meat on top of the stove. Heat comes up on each side of the meat when device is shut and gravy is caught in a trough at the bottom of broiler

Floor Polishing Made Easy

Attach one more appliance to the electric-light socket and another laborious household task is lightened—waxing floors. This new electric floor polisher (below) may be used also on linoleum. A fine bristle brush mounted in front of the machine is driven at high speed by an inclosed motor. Because of its flat shape the polisher can be run under heavy furniture and radiators too



Mrs. 1926 Cleans Windows

Washing windows without bucket or sponge is almost as easy as sweeping a floor. A felt pad in this outfit holds enough water to wash three or four windows, while a squeegee, used on the same holder, dries them. A brush may be attached for use on walls, stairways, window sills, and floors



Lemon Squeezer Resembles a Nutcracker

There are some women who have not enough strength in their wrists to extract all the juice from a lemon in the ordinary way. They will have no difficulty with this lemon squeezer that is shaped like a nutcracker, shown at the right. Rough surfaces of the jaws of the squeezer hold the lemon firmly



Reforming the Salt Shaker

Press the top of the shaker shown below and out comes the right amount of salt or pepper. The quantity is adjusted by turning the knob—to the left for more, to the right for less. The shaker is filled by unscrewing the cap



Functions like a Thermos Bottle

This new automatic electric heater tank for bungalows and larger houses, is constructed like a thermos bottle on a large scale. Water in it remains hot a considerable time after the current has been turned off



Try These Shears when Carving Poultry

In cutting up poultry for fricassee or carving it on the table, these poultry shears are a welcome addition to the carving knife and fork, as shown



Fireproof Ironing Board

Another fire hazard is avoided with a cabinet and ironing board made entirely of steel, built right in the wall. There is a raised platform for the iron while garments are being arranged on the board. There is also a rod that swings outward for a towel or handkerchief rack. This rod holds the board in its niche when the ironing is finished



Home Comforts

Become Simple, Every-Day Routine

Extension Table Has No Loose Leaves

One person can open this newest extension table by pulling at either end. The extra leaves are in the table itself. They are not taking up space in a crowded room or closet. The legs remain stationary. A table seating six persons when closed will extend to allow room for ten



Fireless Cooker and Stove

A combination electric stove and fireless cooker illustrated below, would seem to have reduced cooking to the utmost simplicity. The current heats the plates in the cooker, then shuts off automatically while the cooking continues



Electric Range Carries Off Odors

No chance for odors to escape into the room, for the electric stove illustrated above is built in the wall cabinet and has a special hidden ventilating flue of galvanized pipe. It takes up little room in the kitchen and has the advantage of having no legs around which to sweep and mop when cleaning



A Five-in-One Can Opener

A few turns of the key handle and a steel wheel remove the tops of tin cans cleanly. This new can opener also will punch holes in cans, open pop bottles, remove bottle caps, and serve as a screwdriver. A five-in-one tool that most housekeepers delight in

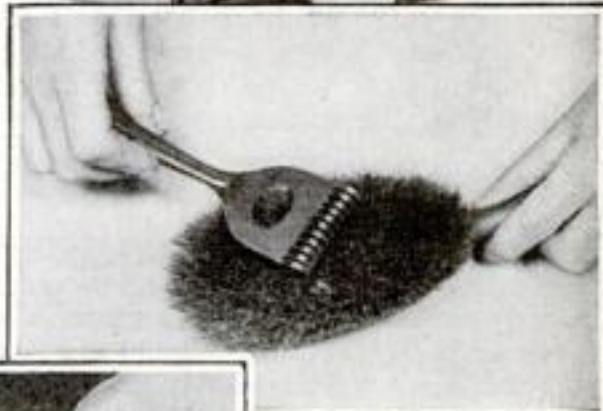
Safety Wringer Belt

A feed belt (at right) carrying the clothes to the wringer keeps fingers seven inches away from the rollers. There is, too, an automatic stop that shuts off the motor. This safety device fits any electric wringer



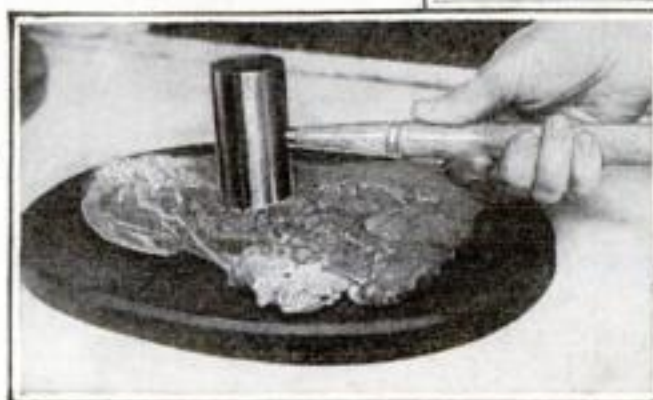
Hollow Steak Mallet

Just lay out a piece of tough round steak on a board. Take this hollow mallet (shown below) with a sharp cutting edge on both ends and you soon will have a tender piece of meat. The construction of this new steak hammer enables it to be cleaned easily



Folding Stand for Garbage Can

This folding steel stand was invented because most garbage cans are too low to be used conveniently. It also insures longer wear for the can, raising it above damp floors or above the ground if the can is kept outside the kitchen door in the yard



Small Rake Is a Brush Cleaner

Somewhat like a curved rake is the useful nickel-plated brush cleaner shown above. It merely is drawn through the bristles of the brush, removing hair and dust. A separate rake can be kept for miscellaneous brushes used in the house

Powerful New Ray

Discoveries that Add to the



Novel Instrument Detects Your Moods

This cone-shaped instrument, which its inventor, Father de Heredia, of New York City, calls a "microvibroscope," measures the infinitesimal vibrations of the human body

Each month POPULAR SCIENCE MONTHLY records in these columns some of the outstanding achievements of scientific progress. In all parts of the civilized world trained minds are constantly at work on new problems that make for the health and the wealth of nations, adding to the sum of useful knowledge in practically every field of human endeavor. Here are a few of the latest discoveries that challenge our attention.

"Super X-Rays" Discovered

AT THE recent convention of the National Academy of Sciences, held at Madison, Wis., Dr. Robert Andrews Millikan finished reading his paper and sat down. For a moment there was silence; then came a murmur that grew in volume until no one could hear his neighbor. The members recognized that it was a new discovery in science, just as when Roentgen reported the discovery of X-rays and M. and Mme. Curie announced that they had isolated radium.

This is what Doctor Millikan told them: Shooting about in space in every direction, with the terrific speed of light, and beating constantly against the earth, are rays more powerful and penetrating than any we ever have conceived of. The "hardest" X-rays that we produce in our hospitals cannot go through half an inch of lead. These new rays, originating somewhere out in space, will go through six feet of lead before they are extinguished.

Their wave length is almost unbelievable. They are shorter than ultra-violet waves, shorter than X-rays, or even the gamma rays of radium. They are the length of one ten-millionth of an ordinary light wave, which measures about one fifty-thousandth of an inch.

No one knows where the rays come from. They originate somewhere out in space, apparently when atoms break up, or when new types of atoms are formed. Doctor Millikan says that if we could generate enough energy for transmutation of metals—for example, change mercury into gold—that would bring forth the penetrating rays as a by-product.

But this would take the immense energy of ten million volts.

The amazing discovery of immigrant rays is the climax of 20 years of research. For a long time scientists have noticed something mysteriously disturbing their electroscopes—instruments used to detect free electricity in the air. Doctor Millikan, searching for the cause, went outside our highest atmosphere. He sent up delicate featherweight instruments in tiny captive balloons from mountain tops in Colorado, many miles above the earth's surface, into regions where man could not go. Others

were sunk 60 feet in snow-fed lakes. These experiments eliminated certain factors and showed that the rays existed.

For measuring the electron, the Nobel prize for physics was given to Doctor Millikan in 1923. His latest achievement crowns a unique record.

What Is a Microvibroscope?

FATHER C. M. DE HEREDIA, a Jesuit priest at St. Francis Xavier's Church in New York City, has perfected a machine called a "microvibroscope," which, he says, measures the infinitesimal

vibrations of the human body. And the markings made by the machine, he asserts, analyze moods and personalities and detect ailments.

It was the Russian ouija board that gave Father de Heredia the idea for his mood detector. A brass pendulum swings by a silk thread from a brass disk. The subject puts his finger tips on the disk and apparently communicates vibrations to the pendulum, which starts swinging in various circles and curves. The priest says that certain basic curves recur every time the same person uses the instrument, but there are deviations that he believes show variations in moods and health. Two persons suffering from the same disease, he says, will produce similar curves on their charts.

A New Triumph for Radio

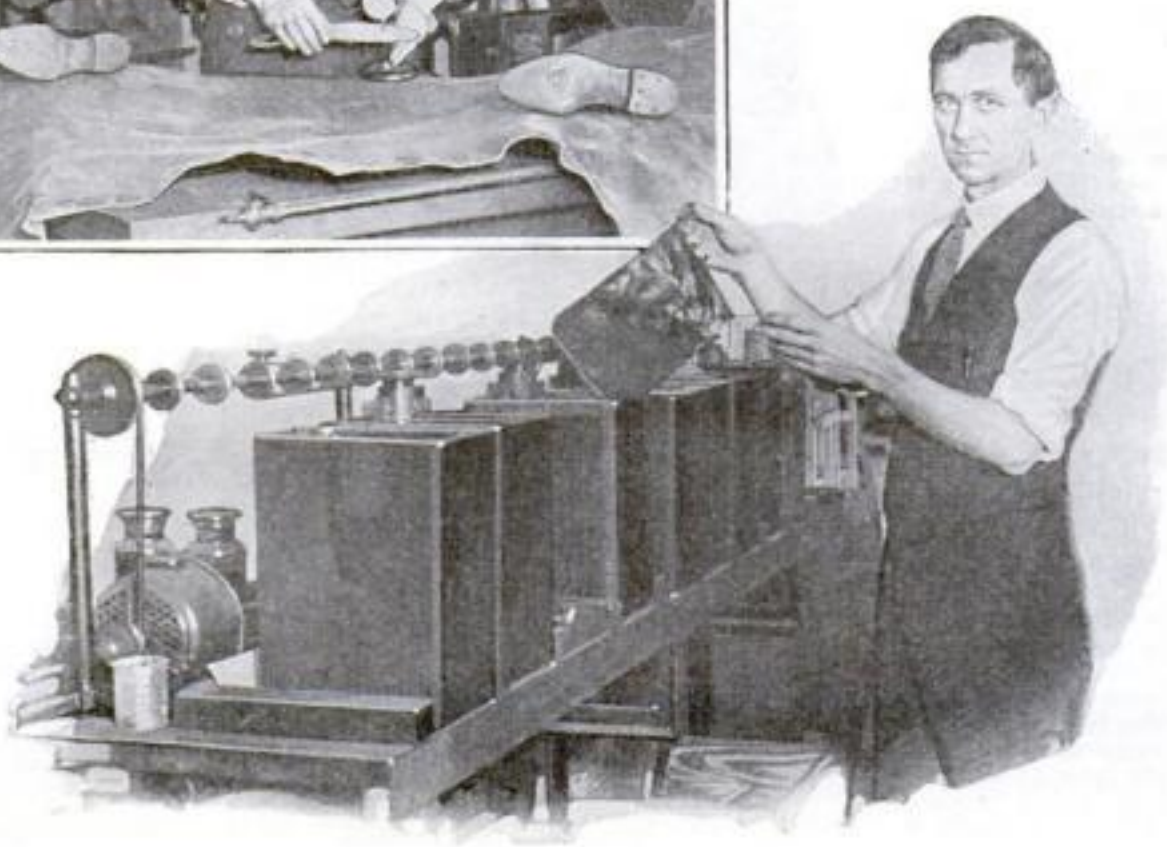
A TRAIN came tearing along at 50 miles an hour. In the engineer's cab a small red light flashed, and in an instant the wheels shrieked and the whole train came to a sudden stop, the throttle still wide open. An unseen hand had prevented an imaginary wreck.

In this successful demonstration recently on the Pere Marquette Railroad near Detroit, Mich., radio had a new triumph. It was proved that it would warn of danger on the track ahead many minutes in advance, and, should the



To Save Your Soles

Left: R. C. Bowker, chief of the Leather Laboratory, U. S. Bureau of Standards, making measurements that prove that shoe soles cut from one part of a hide will wear twice as long as those cut from another. Below: E. L. Wallace is shown using a new mineral tanning process that, it is claimed, doubles the life of shoe leather



Penetrates Metal

World's Useful Knowledge

engineer be dead or disabled, bring the locomotive to a stop automatically.

"Electric magnetic waves, flowing in the track rails," explained Thomas E. Clark, inventor of the radio-controlled safety devices, "are picked up by loop collector coils under the locomotive's pilot or cowcatcher. They are transmitted to a visual signal device in the engine cab. This has three lights—red for danger, yellow for caution, and green for clear track ahead.

"The red light is flashed only when there is imminent danger of collision. Should a train be occupying a block, the rest of the rail surface within the block becomes automatically demagnetized, and another train entering the block from the rear or front will receive the danger signal and an automatic application of the brakes."

The incoming signals are dispatched automatically by block towers along the line.

Element 75 Is Found

EVERYTHING on earth—fire, water, dirt, plants, and animals—everything in the whole visible universe, including the sun, planets, and stars, is made up of less than 100 different substances called "elements." Most of these have been found, numbered, and put in order according to the structure of their atoms. A few gaps remain.

Doctors J. Heyrovsky and Doleyssek, of Prague, Czechoslovakia, have announced the discovery of No. 75, one of the missing elements. They have named it "bohemia," in honor of Bohemia. Not long ago three German scientists claimed to have discovered 75, too, and also 43. If these two are verified, then only three missing chemical elements will remain to be discovered—numbers 61, 85, and 87.

Will Jupiter Devour Us?

SOME day the planet Jupiter is going to reach out and gobble up the earth. So says Prof. W. D. MacMillan of the University of Chicago, on the basis of new mathematical studies.

All of the planets, he explains, as they soar along in space, sweep up star dust. As they gradually get bigger, the attraction between planets increases, and the bigger planets will gather in their neighbors.

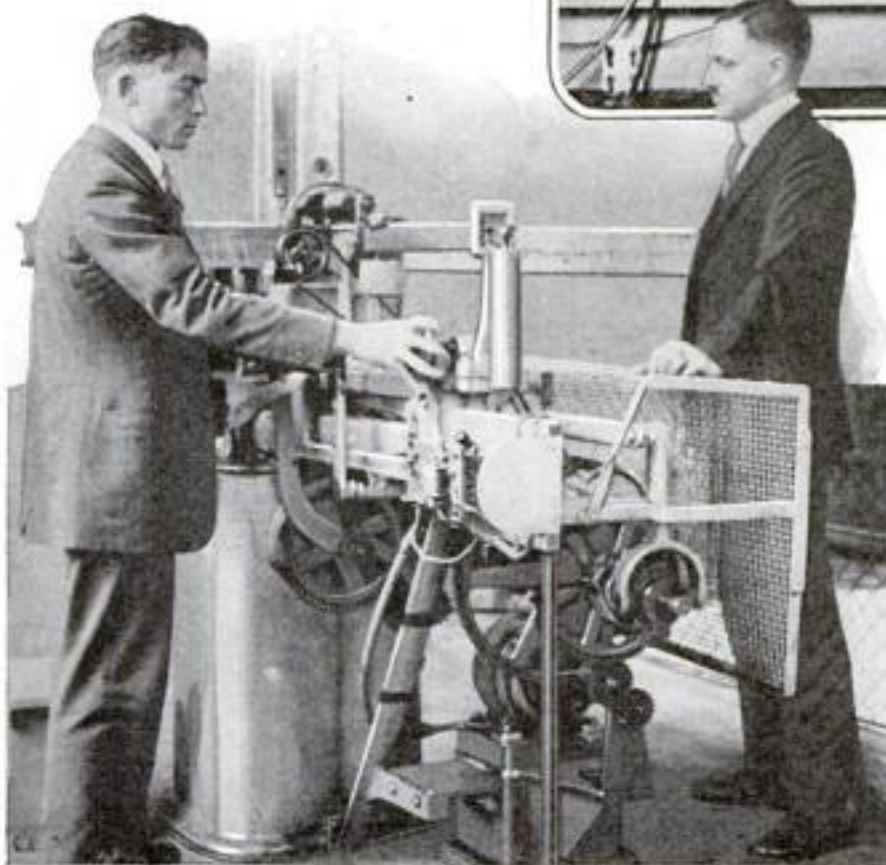
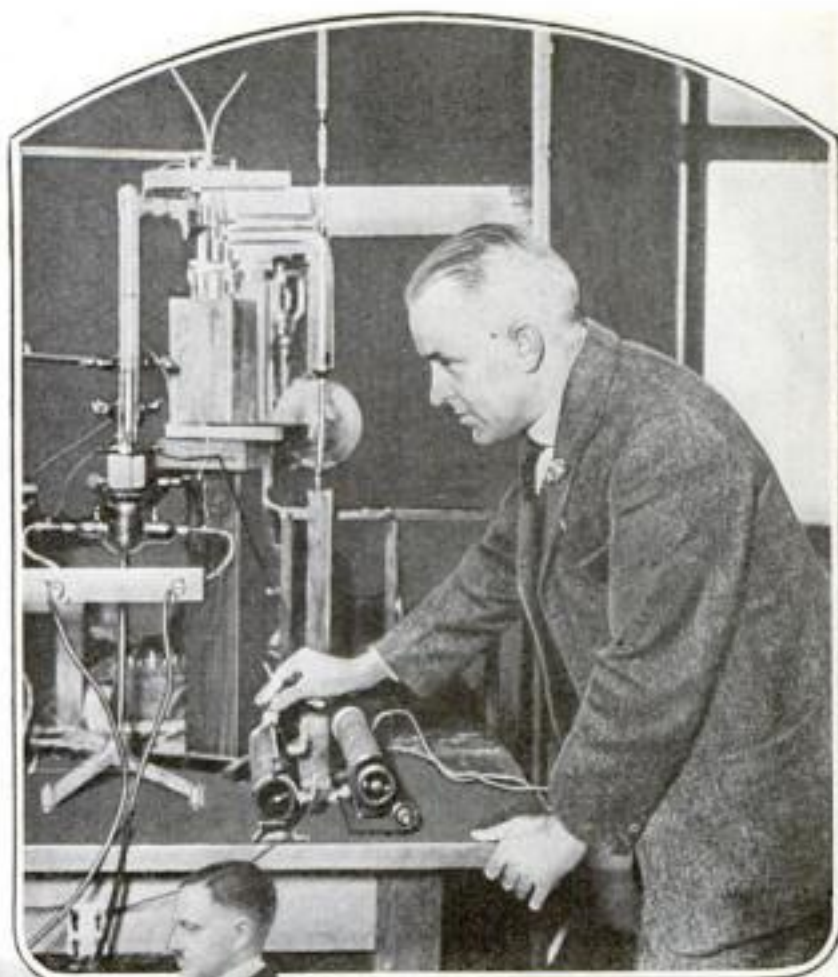
Jupiter, being the largest, will end by getting them all, including the earth, and become a star, probably 500,000,000,000 years from now. It then will have only one rival, the sun, and the two together will make up a double star. About 40 per cent of the stars in the heavens are of this double kind, and Professor MacMillan believes that many of these at one time were solar systems like ours.

A Pathfinder of Science

At the right is Dr. Robert Andrews Millikan, of the California Institute of Technology, who recently announced the discovery of rays more powerful than any we ever have known

Strength of a Screw

Below is an ingenious machine with which the U. S. Bureau of Standards determines the holding power of wood screws. It answers the inquiry—"How much force will it take to pull any sort of screw out of a particular kind of wood?"



Cold Storage

NEW refrigerating methods used in Canada can preserve a fish for six months or more, it is claimed, so that it will taste as if it had just been caught. The secret is to freeze foods very rapidly instead of slowly, as heretofore.

In rapid freezing, several methods are used. One is to wrap fish in waxed paper, pack them tightly in narrow cans, and sink them in a circulating bath of brine kept near zero temperature. Pieces of haddock have been frozen by dipping them in liquid air. This freezes the meat instantly and makes it brittle. Liquid air is too expensive at present to be used for refrigeration on a large scale, but if some cheap way were found to make it, this probably would be the simplest way of freezing foods for storage.

Nature Uses This Anesthetic

THE fizz in the pop bottle has gone up in the world, for surgeons are considering seriously its use in the operating room. Common carbon dioxide that gives sparkle to your soda water may be as useful an anesthetic as ether and the other aristocratic gases.

At a clinic recently held in Philadelphia, Dr. Ben Morgan, of Chicago, demonstrated its use before the Eastern Society of Anesthetists. Carbon dioxide, Doctor Morgan explained, is the non-poisonous anesthetic used by nature itself. If you are hurt badly in an accident, your breathing is lessened, and an excess quantity of carbon dioxide in your blood makes you fall asleep.

Three Violins in One

AN "ORPHEUS violin" is a new instrument that was recently exhibited in Paris. Music for the violin, alto, and cello can be played on it. Air forced by an electric blower is emitted from 58 openings, and the sounds, it is said, have a peculiarly rich timbre.

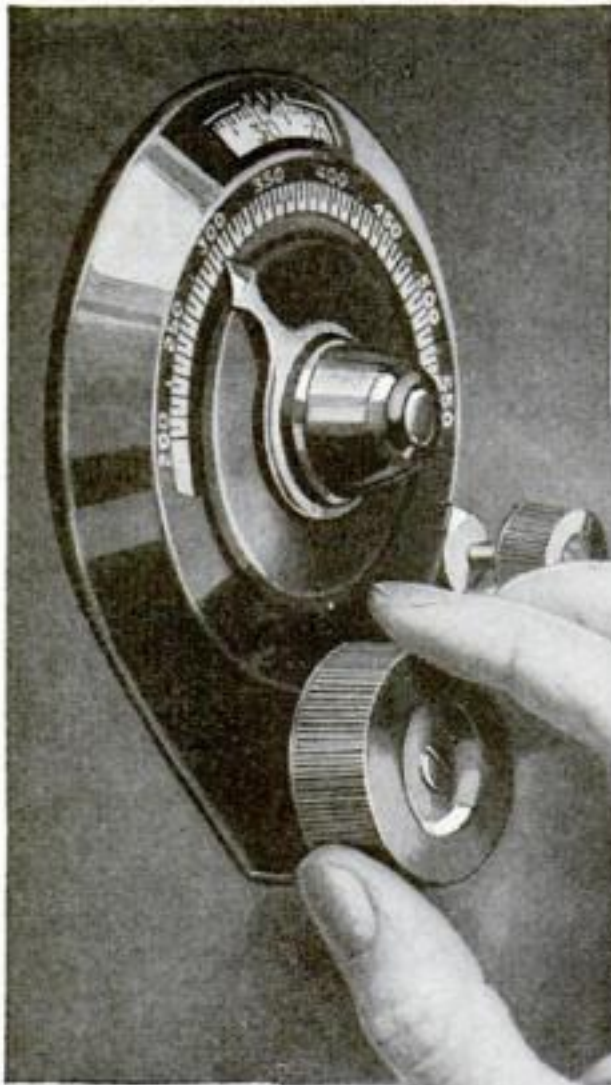
We'd Freeze on Mars

EVEN if we should find a way to get over to Mars, we couldn't go—at least, not until we had rigged up some sort of an electric suit that would take heat with us. For landing on that inhospitable shore, we should freeze more solid than icicles, owing to the extreme severity of the climate.

Doctor W. B. Coblentz of the U. S. Bureau of Standards, using extraordinarily delicate instruments of his own invention, has concluded that 100 degrees below zero is just ordinary temperature in our frigid neighbor's clime. Almost every night, in winter, he says, it goes down to 70 degrees Centigrade or 158 degrees Fahrenheit.

Doctor Coblentz made many of his measurements in Arizona last August, when Mars was in an unusually close position to the earth.

Remarkable New Set Help to Get



On distant stations accurate tuning keeps the music clear and undistorted. A good vernier dial will be found a real help

IT IS quite possible to tune a radio receiver without any dials at all. Your fingers could grip the projecting ends of the condenser shafts and turn them back and forth and if you had sufficient perseverance, you would be able to get the music. But that certainly would not be an easy way to tune a radio set. And the next time you wanted to listen to the same station you would have to go through the same tiresome process all over again.

The dials on your radio set are extremely important. The knobs make it easy to turn the condenser shafts, and the figures show you how to get a station once you have logged it. With modern radio receivers, however, the tuning is so sharp and critical on distant stations that something more than a plain dial is needed for really good results. Manufacturers have responded to the demand for finer tuning with dials so finely constructed and so marvelously accurate that even the beginner may tune his set with a precision hardly to be equalled by the most expert radio fan using the old type of plain dial.

The new dials are made so that a considerable amount of motion of the knob turned by the fingers results in a much smaller motion of the condenser shaft. This means that with the new vernier types of dials, you will have no difficulty in setting the condenser precisely at the point where the broadcasting is received with greatest intensity. And many of the new models also provide for much greater visible accuracy, so that you can reset the condenser to the same station with extreme precision.

These results are obtained by gearing down the motion of the knob with relation to the shaft and to the dial or pointer that

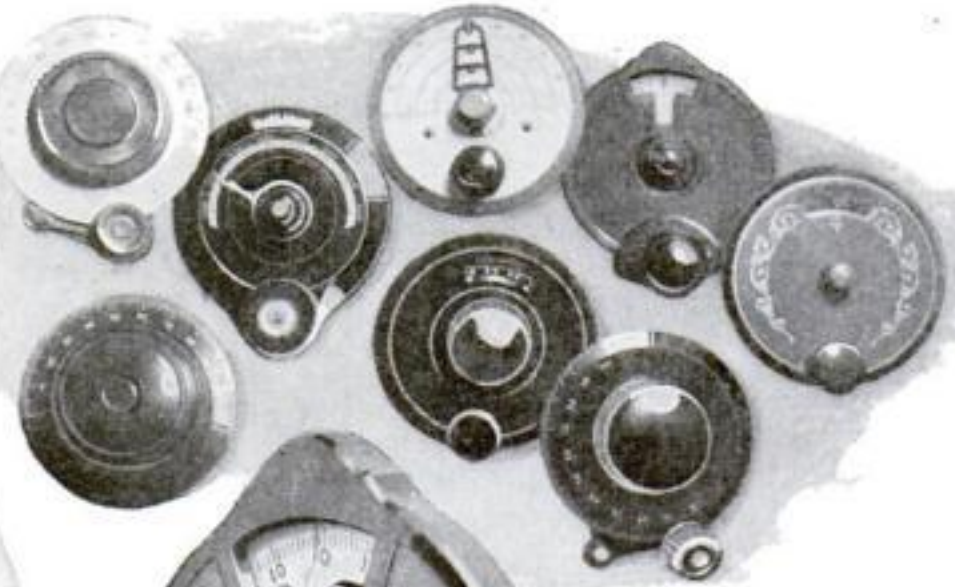
is attached to it. There seems to be a wide difference of opinion as to the correct gear ratio. Some manufacturers insist that a 5 to 1 ratio is right, and other makers are turning out vernier dials with ratios as low as 150 to 1.

Of course, the actual mechanical ratio is not the whole story by any means, for the size of the knob the radio fan must turn with his fingers has an important effect on the ratio. Two vernier dials, for instance, may be so made that it takes 12 turns of the knurled knob to revolve the shaft of the condenser through a full circle. Yet if one of these two dials has a smaller knob than the other, the effective reduction of the two dials will not be the same.

What counts is the actual motion of your fingers in relation to the change in degrees on the dial or pointer. Other things being equal, the smaller the knob the higher the gear ratio. For this reason a 12 to 1 vernier dial may give just the same effect as far as fine tuning is concerned as a 6 to 1 instrument if the latter has a knob twice as large in diameter. Keep this fact in mind when you are selecting new dials for your radio receiver.

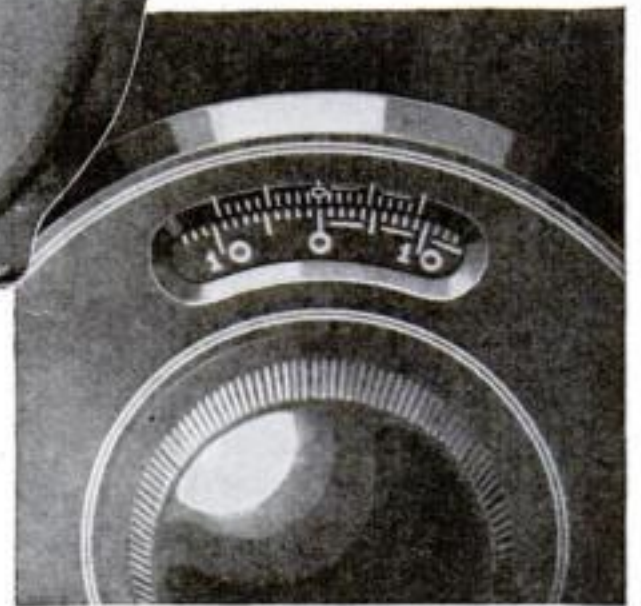
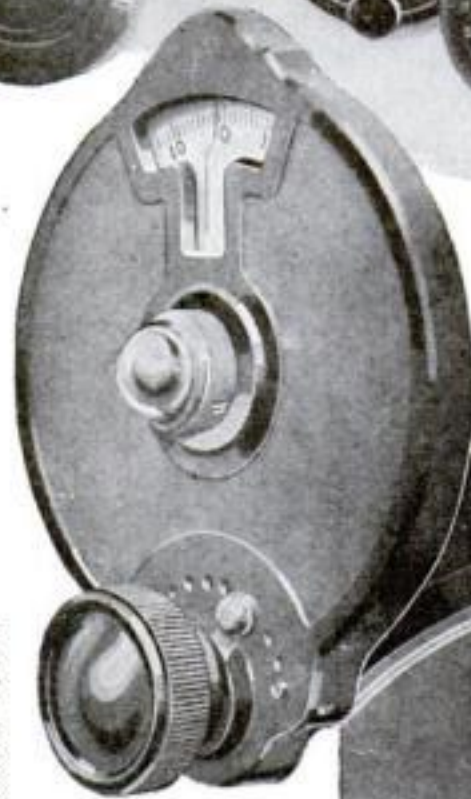
THE ideal vernier dial should operate with a smooth, velvety motion. There should be no perceptible lost motion. In other words, when you start turning the control knob in the opposite direction, the dial and condenser shaft should immediately start to move in the opposite direction also.

The numbers on the dial should be



Many Types Are Available

Fig. 1 (above): You can get a dial to suit your own tuning problems, with either a pointer or a revolving scale. Fig. 2 (at left): This type has a variable ratio. Moving the small lever gives any ratio from 6 to 1 to 20 to 1



Accurate Setting Made Possible

Fig. 3. The vernier scale makes it possible to set the dial to the tenth part of a degree so that logging can be done with extreme precision

clean cut and set close enough to the pointer so that you cannot get a false reading if your eye does not happen to be directly in line with the indicator.

The correct gear ratio is largely a matter of personal preference. Some prefer a low ratio, while others maintain they can tune more quickly and with equal accuracy using a dial that has a 5 or 6 to 1 ratio.

It depends to some extent on the particular radio receiver, of course. If you have no difficulty in tuning with plain dials because a half degree or so does not make any difference in the strength of signal, then vernier dials will not be of any advantage.

In these days of congested wave lengths, where so many stations are close together, a broad tuning receiver is almost useless anyhow, and if your receiver tunes with the sharpness common to most modern receivers, you will find vernier dials distinctly worth while.

Dials for *Your* Radio Distant Stations

By ALFRED P. LANE

And, aside from any question of increased efficiency, modern vernier dials are so attractively designed that they will greatly improve the appearance of your receiver.

There are two ways in which dials can be built so that the dial and condenser shaft turn much more slowly than the control knob. One way is to use gear wheels, and the other is to use a friction mechanism. Both methods are practical, and if design and workmanship are good, there is little to choose between them.

IN FIG. 1 you will see a number of modern vernier radio dials such as are obtainable from the radio dealers. Of course this group does not include all the different types available, nor even all of the good makes.

Figure 6 shows the back view of two of the dials. These are good examples of the straight, geared type of vernier. The one on the left uses an internal gear and the other uses the ordinary spur gear. When carefully constructed, there is but little lost motion. Figure 5 illustrates two types of vernier dials in which a spring is used to hold the gears in mesh. There is no lost motion whatever with this type of construction. It is used in somewhat different form on other makes of vernier dial now on the market.

Spiral or worm gearing has been used to some extent in vernier actions, and Fig. 4 shows this method as applied to a dial that can be attached to any condenser shaft. The spiral in the knob works a worm that, in turn, moves the teeth on the main dial, which is attached to the shaft.

Friction gearing is used in a number of types of vernier dials. Figure 2 shows a close-up view of a dial that recently has appeared on the market. This dial uses a friction mechanism arranged in such a way that

any desired ratio, from 6 to 1 to 20 to 1, can be obtained simply by shifting the small lever at the bottom.

On most modern vernier dials, the graduations can be read easily and accurately, so that it is possible to reset your condensers to any given station's wave length with great accuracy. Figure 3 shows to what extremes this desire for accurate setting may be carried. You will note that a vernier scale has been stamped on the metal opposite the divisions on the dial in such a way that it is quite easy to set the dial to one-tenth part of a degree.

Fitting vernier dials on your radio receiver in place of plain dials is, in most cases, a simple screwdriver job. Many types can be fitted merely by loosening the setscrew of the plain dial, slipping the old dial off the shaft, slipping the vernier dial on in place of it, and tightening up the setscrew.

Other types require the drilling of one small hole in the panel through which a screw is bolted to hold the frame of the vernier stationary when you turn the knob. In most cases, the shaft of the variable condenser can be left as originally turned out by the manufacturer, but some forms of vernier dial require that the shaft be cut off slightly.

There is one point to remember in fit-

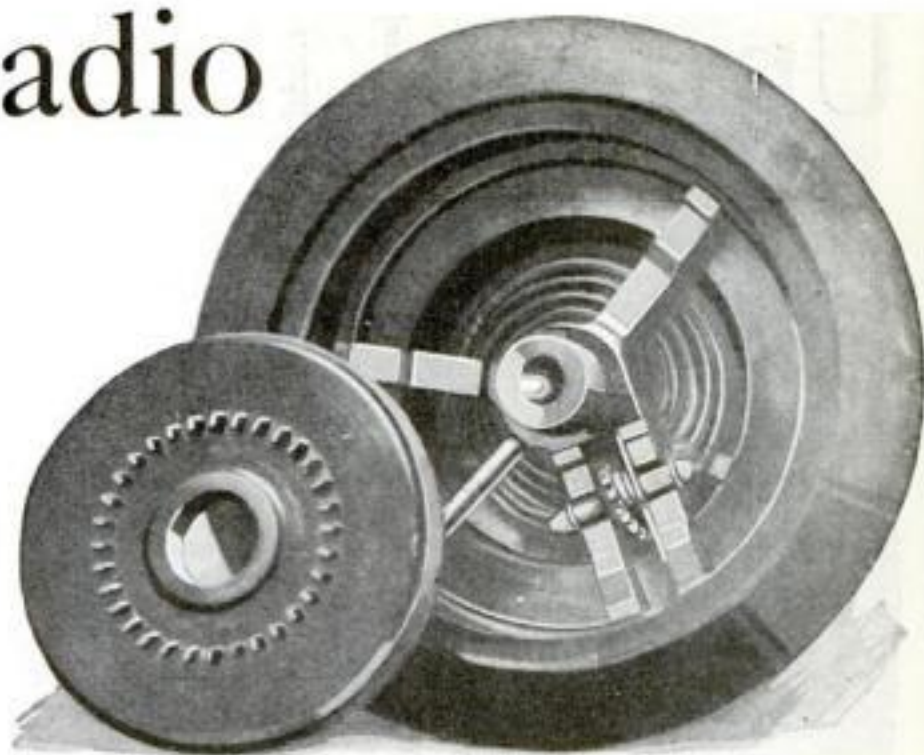
ting vernier dials. Be sure that the condenser shaft turns rather freely. If it turns stiffly, extra strain is placed on the vernier mechanism. In the friction types this may result in slipping, or, in the geared types, in excess wear. This point usually is mentioned in the printed instructions. The recommendation usually is made to set the friction on the condenser so that it will be just sufficient to maintain the shaft stationary when the plates are in any position.

JUST what type of vernier dial to buy for your radio set is a matter for you to decide. It is desirable, of course, that the design and color or finish of the dial match with the panel and the other control knobs on your set. But if you prefer a dial of some one particular type, there is no reason why you cannot buy new knobs for the other controls on your set so that the complete arrangement will present a pleasing appearance.

Some of the new types of dials are so constructed that a space is provided where you can write directly on the dial the call letters of the broadcasting station at the point where the station is received best. This is of little importance to the radio set owner who tunes the set himself, because the dial numbers of all the regular stations soon become fixed in the memory and the log can be consulted when fishing for distant stations. Such dials are a great advantage, however, if other members of the family occasionally wish to tune in stations.

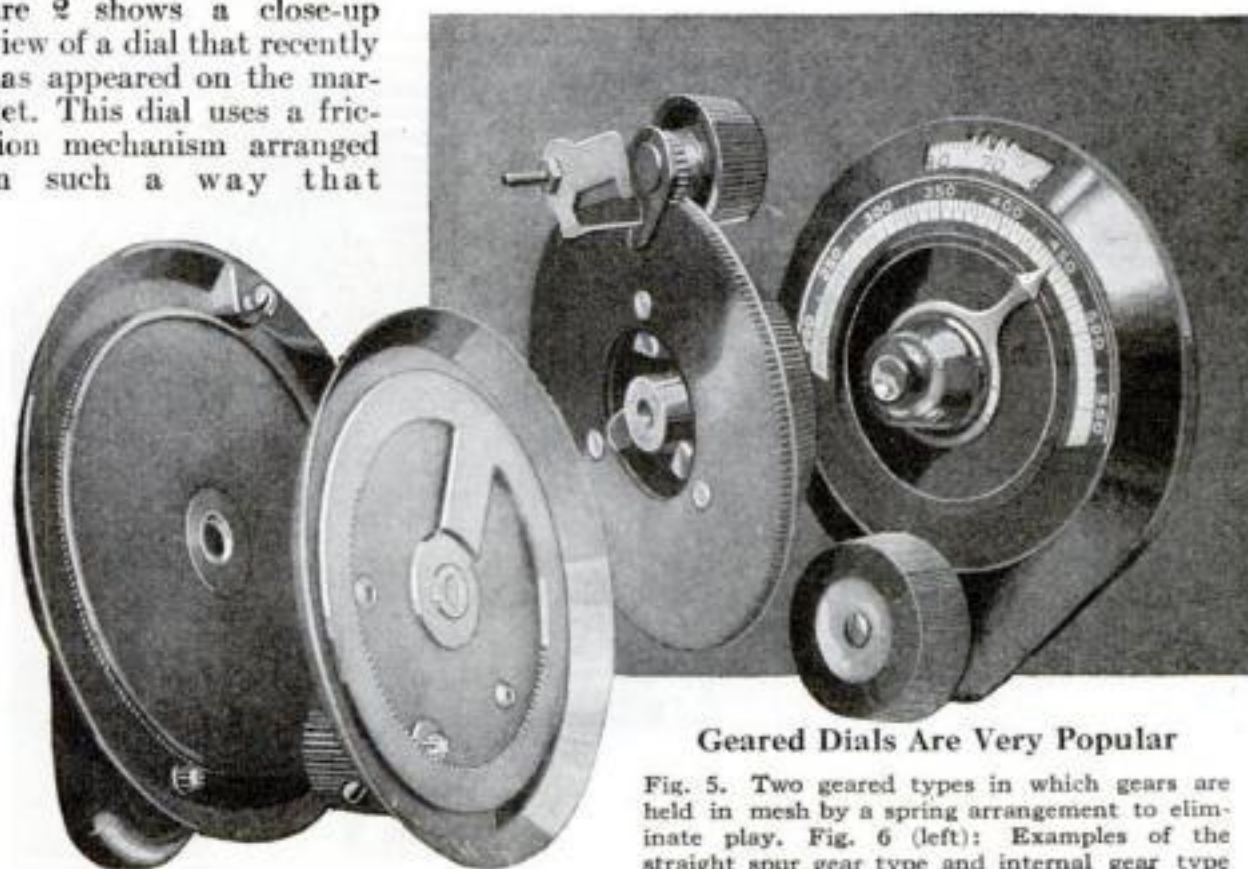
A good vernier dial is a precision instrument and the value you get out of it will be in proportion to the care you take in fitting it to the shaft, so be very careful to read over the instructions and follow them.

Radio dealers everywhere now stock vernier dials of various types and a number of styles have been approved by the Popular Science Institute of Standards. A list of these dials and other radio apparatus is available and will be mailed on request.



This Worm Drive Dial Has a Very Low Ratio

Fig. 4. The spiral cut in scroll fashion on the back of the vernier knob rotates the brass gear that is worm shaped and engages with the teeth cut on the disk at the left. The disk, of course, is mounted the other way on the dial and this double reduction gives a ratio of 150 to 1. This type of dial is designed for the fan who prefers an unusually low ratio



Geared Dials Are Very Popular

Fig. 5. Two geared types in which gears are held in mesh by a spring arrangement to eliminate play. Fig. 6 (left): Examples of the straight spur gear type and internal gear type

Unusual Radio Ideas

*Novel Loudspeakers;
Other New Devices*



Unique "Snap" Tuning Dial

To facilitate tuning, George Jacobson, New York radio fan, has devised a knife-edged piece of metal which is to be attached to the dial. This edge snaps into notches cut at points where stations are found on a curved piece of metal fastened to the panel.

Wall Screen Is Radio Antenna

A thin sheet of copper foil placed between two sheets of insulating material forms the novel screen antenna shown at right. When not in use it may be rolled up tightly on the lower roller and stored.



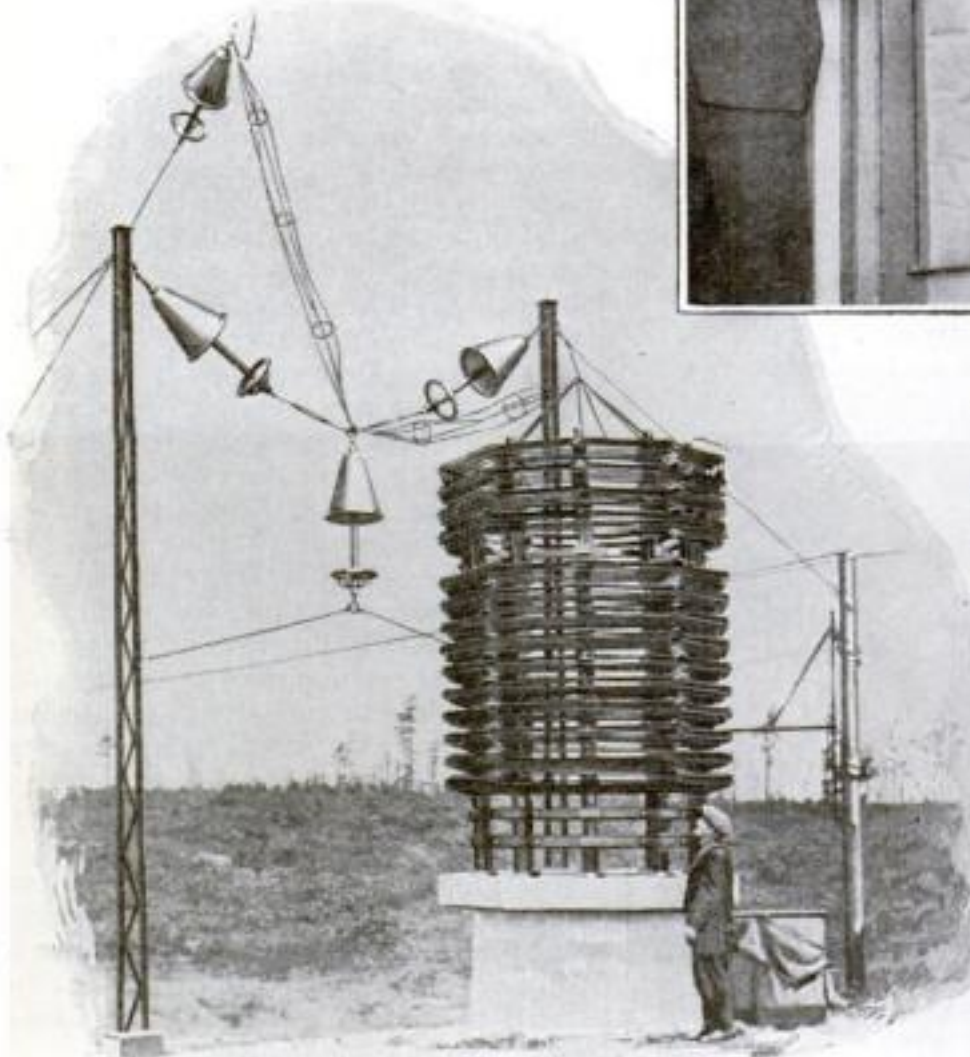
This Speaker Has Two Cones

Distortion on loud volume is eliminated by using two cones, according to the manufacturer of this novel type of loudspeaker. In the center may be seen the powerful permanent magnet that works with coils of fine wire to operate the cones. A cover that protects the cones from injury through an accidental jar or bump while the speaker is in operation, has been removed in order that the construction of cones may be seen.



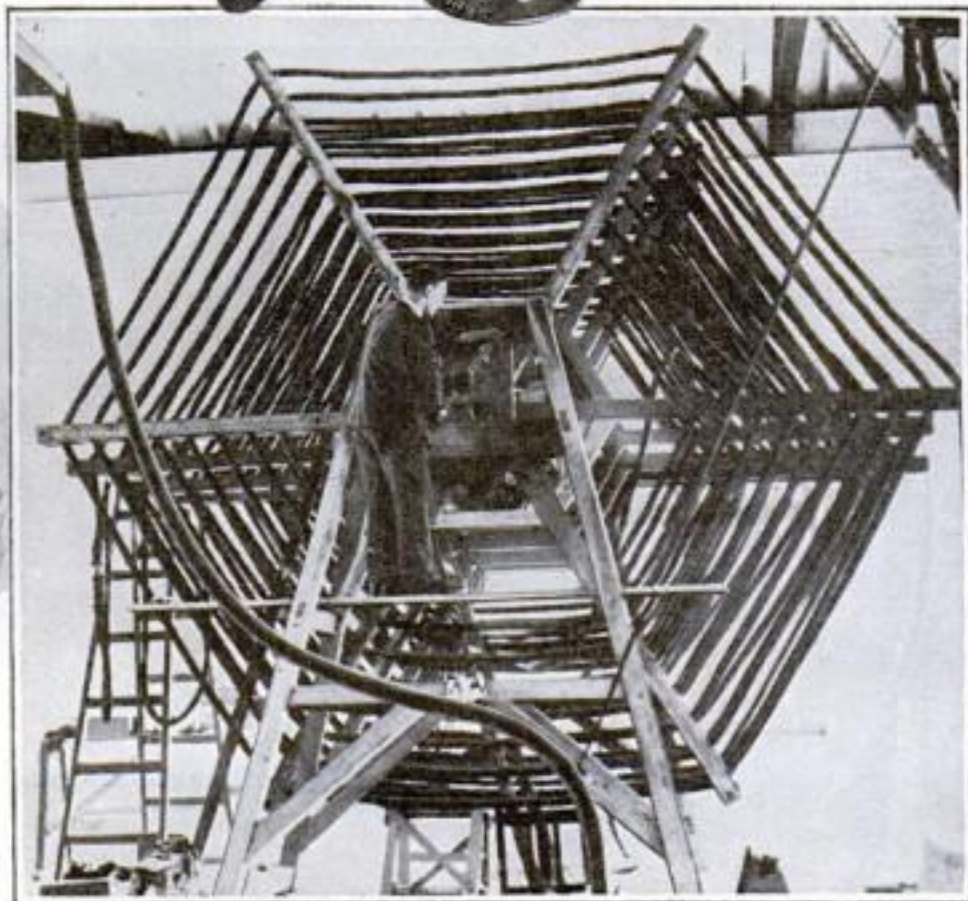
Double Horned Speaker

The larger horn is made of fiber composition and emphasizes the lower notes produced by the loudspeaker unit concealed in the base. The short horn projecting from the side is made of metal. This horn brings out the higher musical overtones and the sibilant sounds of the human voice so that the result is pleasing.



Gigantic Tuning Coils at Rugby

While tuning coils in radio sets usually are small enough to be held in one hand, the tuning coils or inductances at the broadcasting stations must be of a size in proportion to the power of the station. The new radio station at Rugby, England, is of tremendous power and the tuning inductances therefore are of enormous size. This station will be used as part of the system for direct, two-way telephone communication between England and the United States.



Beware of the Battery Gyp!

Crafty Tricks of Crooked Dealers that Cost You Money and Trouble—The Confessions of a Radio Service Man

As told to GEORGE LEE DOWD, JR.

I'VE been in the battery business now for a good many years. Without bragging, I think I can truthfully say that if all the batteries I've seen the insides of were piled in a heap, they'd reach higher than the Woolworth Building.

Right now I'm working for a man who is a square dealer, but in the past I've worked for all kinds of birds, ranging from outright crooks to the fellows who had fits of honesty now and then.

Old man Polakof—which isn't his name, of course—was about the worst. He counted the day lost if he didn't succeed in stinging at least one customer for a tenspot. Of course I'm ashamed of the fact that I worked for him at all, but business was on the blink that year and I couldn't afford to be out of work, what with the wife sick and one thing and another.

There wasn't a snide trick in the business that old Polakof didn't know, and he worked them all whenever he thought he could get away with it. Look at the case of a man named Williams. That shows just how far he would go when he had a real sucker to work on. The old man got Williams on his string by way of a telephone call.

THE bell rang one morning, and from Polakof's talk I could tell that the party at the other end of the wire wanted to buy a storage battery to run a radio set. Polakof assured him that we had the finest batteries in the world—absolutely guaranteed—and invited him around to pick one out.

Polakof came back in the shop with a grin on his face a mile wide and rubbing his hands together like he always did when



Don't Be Fooled by the Short Circuit Test!

"See! It's fully charged," said the battery "gyp" when he tried to palm off a boxful of junk as a brand new battery by burning a wire. A demonstration of this kind is no indication of the quality and staying power of a storage battery, so let buyers beware!

he hooked a new sucker. He walked along beside the bench where I had a lot of old batteries on trickle charge and, pointing to one of the worst of the lot, he told me to polish up the terminals and give the box a coat of black paint. And, by the way, we never used expensive acid-proof paint. Instead, Polakof used to buy the cheapest plain black paint he could get and then thin it out with turpentine so it would dry quick.

I got busy with some sandpaper and the paint brush and in a few minutes I had that battery looking like it just came out of the factory.

Williams dropped into the store after

lunch and the old man had the battery I had fixed up standing on the counter among some brand new batteries of a well-known make.

"I phoned you about a battery this morning," Williams began.

"For a radio set, wasn't it?" cut in Polakof. "Well, here you are—finest batteries made—all positively guaranteed. I can recommend this one specially," he went on, patting the sides of the old wreck like it was a valuable piece of jewelry.

"SEE! It's fully charged—lots of pep." And he proceeded to take a piece of wire and snap it across the terminals to show what a fine spark it would make. Then he deliberately short circuited the battery with the wire that he held in a pair of pliers. "It will burn it up easy," he said as the wire got red hot and finally melted away.

Williams was much impressed and when Polakof stated that he would make a special price of \$14, he paid it without murmuring.

Of course that wire test is pure bunk—any one who is wise to storage batteries knows that. All it shows is that there is some juice left and the internal resistance of even the most hopelessly rotten storage battery is always low enough to let enough current through to burn up a piece of wire.

WE DIDN'T hear from Williams for nearly two weeks, which surprised me—I knew how rotten that battery was. Then he called up to say that something seemed to be wrong, because the tubes wouldn't light any more. Polakof sent me around with instructions to bring the bat-



What Old Age Does to Storage Battery Plates

Good plates and "gyp" plates look alike when they are new. At the left is a high grade new positive plate. In the center is a positive plate that is suffering from old age, and the one at the right is a negative plate that has

lost nearly all of its active material. All storage battery plates end up in the scrap pile eventually, but good plates will last for five years or more, while "gyp" plates very often go to worthless pieces in less than six months

tery back for "inspection." About an hour after I got back the old man called Williams on the phone and told him that the battery had been spoiled by charging it backward. He said that the charger must have been working wrong and he'd better bring that in, too, so it could be adjusted.

Williams swallowed the whole yarn and the next day he left the charger at the shop. Polakof charged him \$6.50 for overhauling the battery and two dollars for adjusting the charger. What we actually did to the battery was nothing more than to put it on charge and leave it there until Williams called for it. My conscience hurt me so, I gave the poor old wreck an extra good polishing with the sandpaper. Not a blessed thing was done to the charger except to wipe the dust off it.

And so it went for about two months. Every two weeks or so the battery would give up and quit work, and the old man would have some new excuse and Williams would have to pay out some more money.

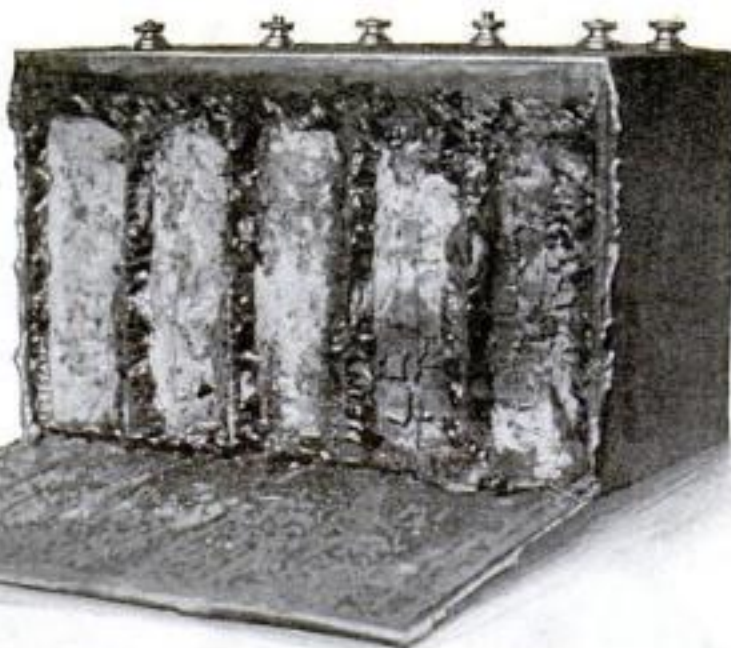
HE FINALLY got wise to himself and bought a good battery from a real dealer. It is a good thing he had a peaceful disposition. He ought to have come in and beaten the old man into a pulp after the way he swindled him; and, believe me, I'd have cheered him on.

The whole trouble is that the battery owner has no way of checking up on the "gyp" battery service station. You have to have special tools to take a battery apart, and without taking it apart you can't tell whether the dealer really overhauled it or not. Lots of batteries were brought in to old Polakof for an overhauling and all he would let me do on most of them was to clean out the muck. Then he would charge the customer for all new positive plates and separators. Cleaning out the muck would make a battery work better for a while.

There was another dealer I worked for whose conscience would not let him deliberately rob his customers the way old Polakof did. When we overhauled a battery we really did put in new plates and separators when needed. But the net results were almost as bad.

THE trouble was that the owner of the business bought his stock of plates and separators from "gyp" manufacturers. The plates looked just like real good battery plates when they were delivered to us, but the material began to fall off almost with the first charge and in a few weeks or months all the active material would be piled up in the bottoms of the cells and the plates would look like the grillwork in front of a cashier's cage. The separators cracked and split and then the loose active material settled between the plates and the battery was short circuited.

There are lots of "gyp" storage battery manufacturers too. I've



A B Battery after Long Service

Note that the zinc cells are almost completely consumed. "Gyp" batteries are made of poor grades of material and because of sloppy workmanship often give trouble through faulty connections and broken-down insulation

worked for several of them. They sell their junk batteries mostly to the cut price dealers, but once in a while they rope in a respectable dealer who decides to go into the radio business and doesn't know the difference between an honest battery and one of the other kind.

Anybody can go in the business of making storage batteries if he wants to. There are no manufacturing secrets to amount to anything. It is just a matter of getting good material and putting it together properly. And it is still easier to turn out junk batteries that look like good ones, because the customer can't see what's inside and wouldn't know the difference if he could.

Cedar wood makes the best separators, but you can bet that "gyp" makers use

a cheaper wood. Some kind of a binder must be used in mixing the lead paste that is placed in the grids of the plates. The binder is cheaper than the lead and there is always a temptation to use too much binder. The solution in the battery, which is made of sulphuric acid mixed with water, also can be cheapened by using a commercial grade of acid instead of the chemically pure kind.

CONSIDERING that "gyp" storage batteries are turned out in an awful rush from low grade materials, by cheap workmen, is it any wonder that a "gyp" storage A battery costs much more than a really good battery if you figure it out on a basis of service at so much a month for the life of the battery?

Storage batteries are not the only place where the "gyp" gets in his fine work. All kinds of gyp dry cell A and B batteries are offered to the radio fan. If you cut them open, they look just like real good batteries. The difference is in the quality of the materials used.

And a good many radio fans haven't any idea of what a good dry cell battery should do. Take this case for instance: The boss sells dry cell B batteries of a good, reliable make. Well, about a year ago, he sold a pair of them to a radio fan and didn't hear from him again until a few days ago. Then he came busting into the store as mad as a hatter, planked down a parcel on the counter and began yelling for the boss. He was out, so I asked him what was wrong.

"Just look here!" he shouted, opening his parcel. "This is the rotten battery I bought from you. It went dead and I cut it open and there is nothing inside but a lot of white powder where the zinc ought to be. Hereafter, I am going to buy batteries from some place where they sell batteries with real zinc in 'em!" And he stamped out of the store before I had a chance for a come back.

THAT sure was the limit! I wonder where he thought the white powder came from? There was a battery that gave him nearly a year's service on a five-tube set. It stayed on the job until every last bit of zinc jacket

was eaten up to supply current to his set. Why, that was an ideal battery! Such perfect service doesn't happen once in a dog's life. And now he'll go down the street and buy a gyp battery that will run his set for maybe a month or two and then go dead completely.

That's where the current comes from in an ordinary dry cell. The solution in the cell eats up the zinc jacket. The black stuff in the cell around the carbon rod in the center is put there for a purpose too. It keeps the cell from getting polarized and the quality of the "mix," as it is called, has a lot to do with the life of the

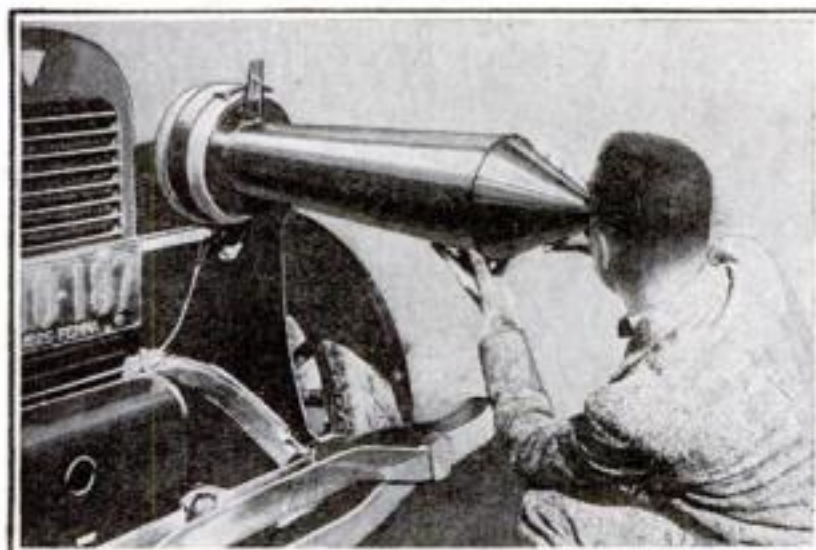
(Continued on page 136)

How an Ordinary Dry Cell Is Made



There is no difference except in size between the large single cell used as A batteries and the many small cells used to make up the high voltage B battery. Long life depends on high quality materials, careful assembly, and proportioning of active materials

Ingenious Helps for the Car Owner



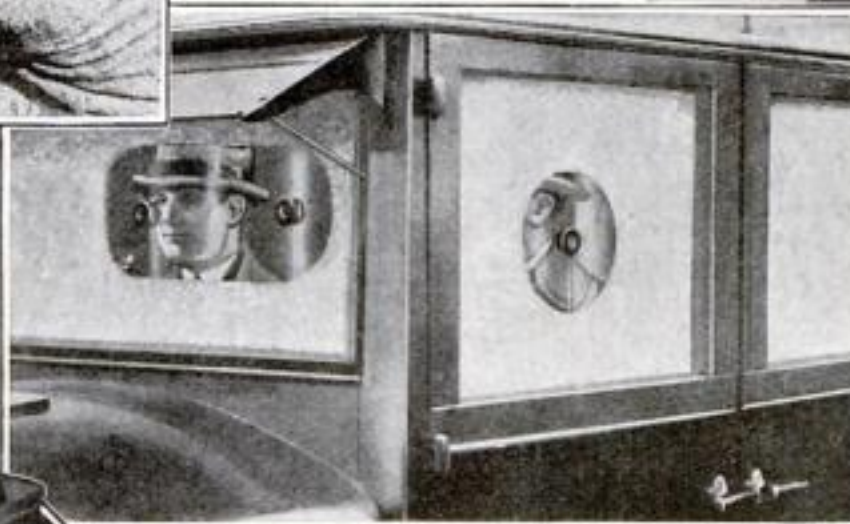
Anti-Frost Window of Celluloid

The celluloid frostproof window pictured below is attached to the glass of the windshield and the side doors by means of vacuum cups so that no drilling or other mechanical work is necessary. The manufacturer claims that it eliminates the blurring effect of frost, mist, or rain.



"Focuscope" Tests Auto Headlights

When one end of this testing device is placed against headlight lens, the tester, looking through the other end, can determine whether the bulb is in focus and whether the beam of light projected by the lens conforms to legal requirements.



New Auto Headlight Subdues Glare

This foreign-built auto headlight is constructed with a curved front lens, and an ingenious arrangement of the reflectors inside the lamp is such that the projected beam of light is spread uniformly across the road, the makers claim, without glaring into the eyes of other motorists.



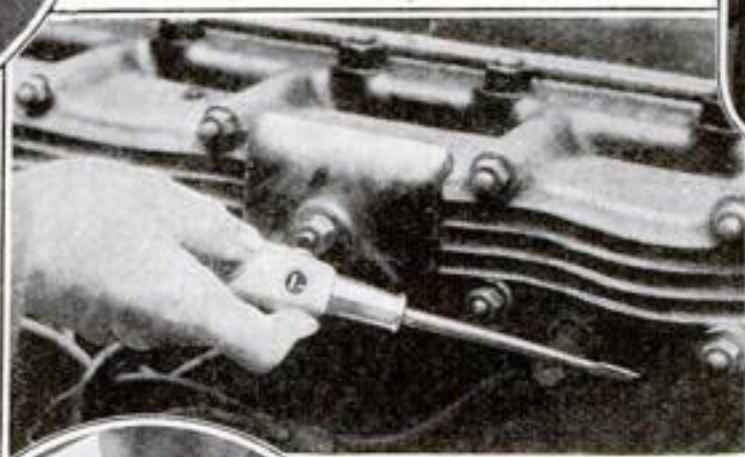
Screwdriver Tests Spark Plugs

Testing spark plugs for short circuit by shorting them with a screwdriver is simplified by a novel tool (below) built with a gap in the handle so that the spark will occur where it is visible.



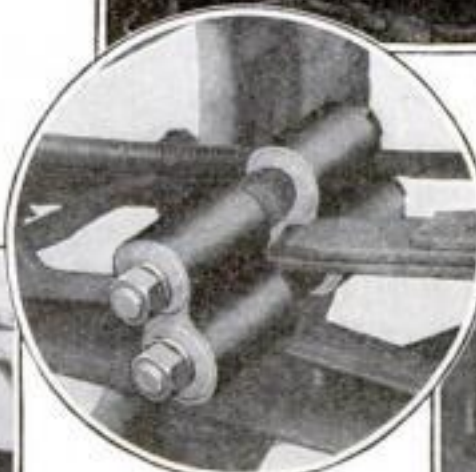
Electric Lock for Auto Doors

In the hub of the spare wheel carrier on this new English car an electric lock is incorporated. When the key is turned, all four car doors lock automatically by electric mechanism, thus saving the trouble of locking each door separately.



Wrench Fits Bolts at Any Angle

Much of an auto mechanic's time is spent on bolts and nuts in hard-to-get-at places. The new wrench shown below is built with a forked arrangement of the handle so that it can be used at any angle.

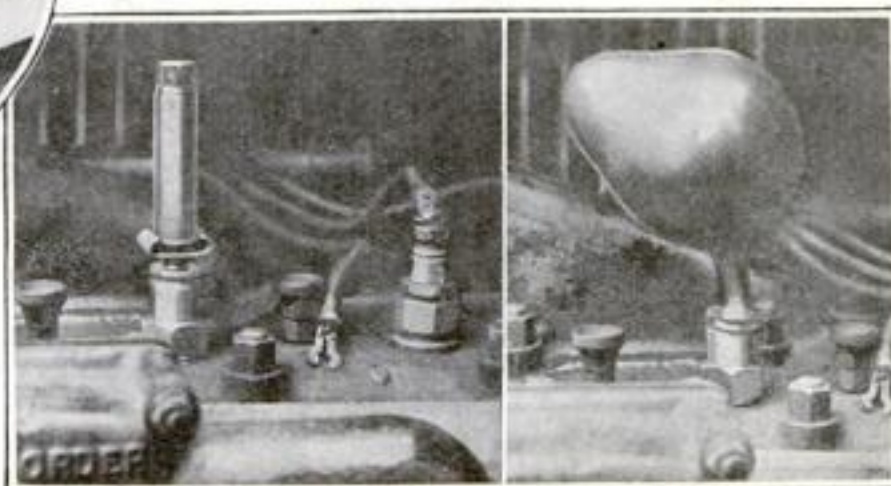


Dimmer Switch in Wheel

Anything to help the driver dim his lights while passing other cars without letting go the wheel will promote safety. In this device the dimmer switch is built into the steering wheel. A touch of the button changes the lights from bright to dim.

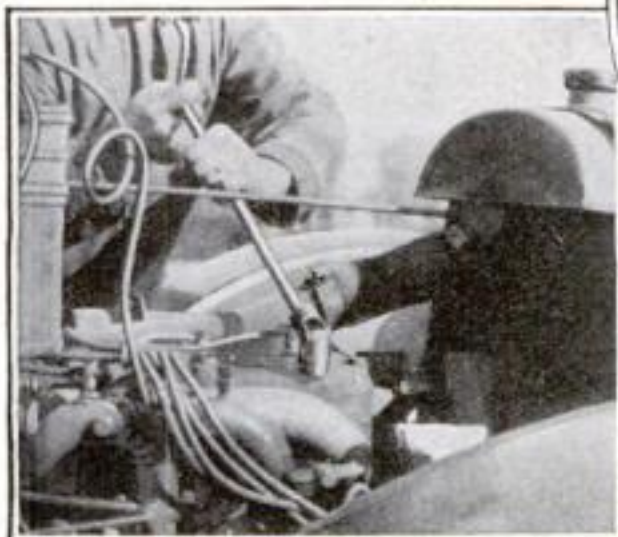
Compression Tester and Leak Indicator

Below is a novel combination fitting that allows the use of a tire gage to determine the amount of cylinder compression, and a special rubber balloon to determine valve and piston-ring leakage. Cranking the engine forces compressed gas into the balloon, and the rate of leakage is determined by timing the balloon's deflation.

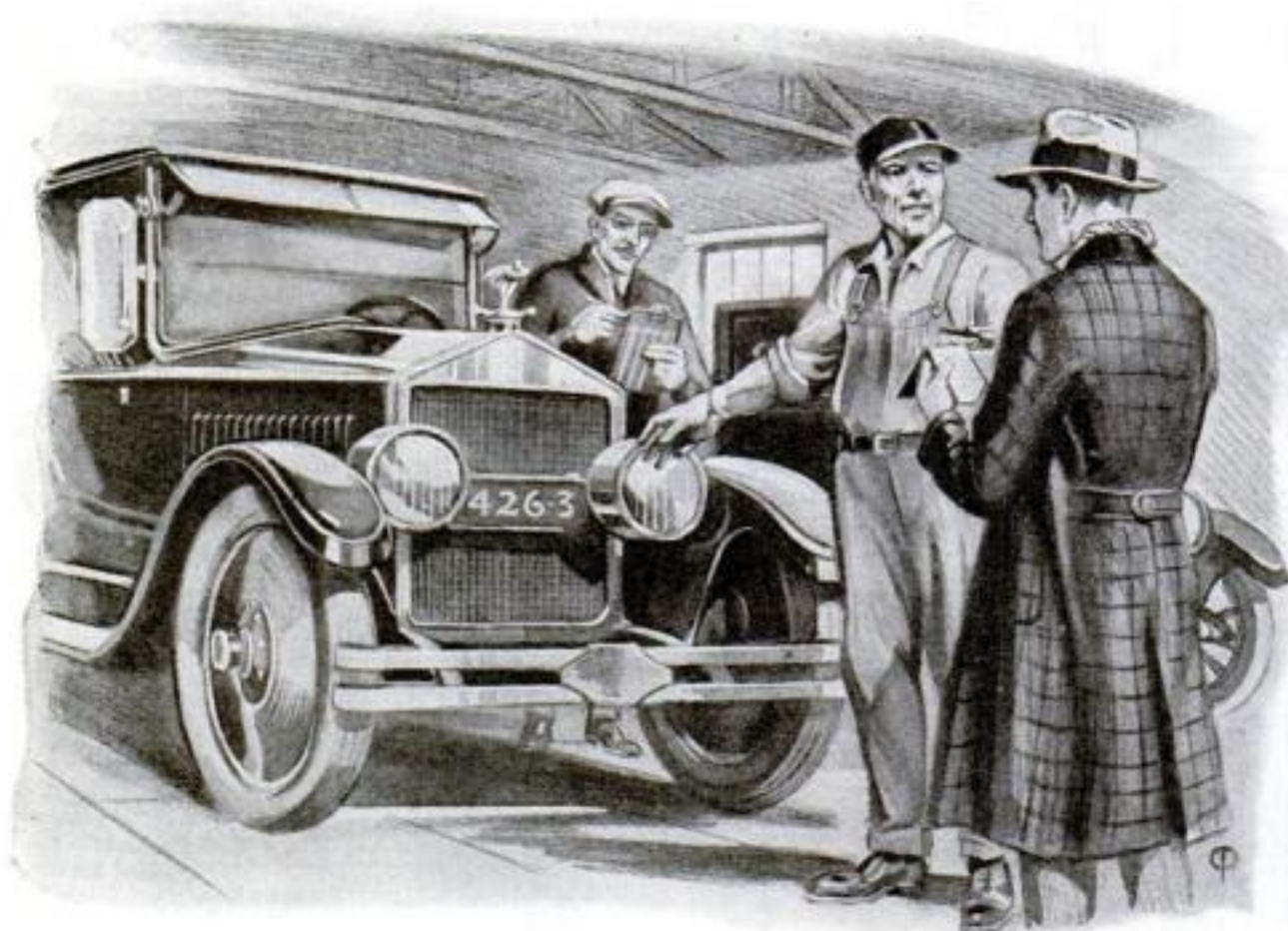


Rubber Spring Shackles

These rubber spring shackles are designed for use on Ford cars in place of metal shackles. The twist of rubber takes up the motion of the ends of the front and rear springs; thus no oiling is necessary.



Does Your Car Fit Your Purse?



Baldwin Gets Good Advice from an Expert

"Now," said Gus to young Baldwin, "that Joe has told you what the repairs will cost, take the car home and make 'em yourself, and start saving money right away. And lay off that errand stuff—that's what eats up car cost." "By jinks, I'm going to try to fix them myself," mused Baldwin

"THIS job is going to nick your bank roll good and plenty," said Gus Wilson, half owner and chief mechanic of the Model Garage, as he looked up from young Baldwin's car. "Your motor is full of carbon, the valves need grinding, the bearings ought to be taken up, and the brakes relined, and I think, from the way she pumps oil, that you need a new set of piston rings."

Joe Clark, who ran the office and sales end of the garage, was figuring rapidly on a piece of paper.

"Let's see," he said, as he totaled the various items Gus had enumerated. "I think a hundred and sixty-five dollars ought to cover it, unless Gus finds something else that needs fixing—and I'm making the price as low as possible at that."

"Holy smoke!" gasped Baldwin. "I guess I'll have to park the car here for the rest of the winter while I try to raise the dough. How about giving me a little time on the bill, Joe. Can you do that?"

"I'd like to," replied Joe. "But Gus and I have to eat, too, so I guess we can't let you have more than thirty days. By the way, Baldwin, seems to me you are running yourself into a hole with that machine. Haven't you found it a bit more expensive than you figured on?"

"You said it!" Baldwin answered gloomily. "I'm making fifty bucks a week and I had a bit saved up, so I made the first payment easily enough. But there have been so many expenses that I never thought about when I decided to buy a car."

"That's just the trouble," stated Joe emphatically. "You buy a car on a shoe-string and you're in up to your neck before you realize it. A lot of people own autos who really can't afford a car at all,

and a lot more buy expensive cars when they ought to get cheap, light ones. And all because they never stop to do a little arithmetic beforehand.

"Look here," he continued, slipping his pencil out of his pocket again. "Unless you're a millionaire, you ought to look at this automobile proposition as transportation at so many cents a mile. And you're kidding yourself if you dope out the cost per mile in gas and tires and let it go at that. Take depreciation, for instance. That car of yours cost around fifteen hundred. In five years it will be about ready for the scrap pile. You may be able to sell it at the end of that time for, say, two hundred dollars. That means you have to charge up thirteen hundred against the miles you travel in that length of time, and if you cover thirty thousand miles it comes to a bit more than four cents a mile.

"GAS at present prices works out to around a cent a mile. Tires—if you are lucky—may cost as little as two cents a mile. That makes seven cents a mile and we have not included insurance, storage, or repairs.

"Insurance runs to about a cent and a half a mile; storage at ten dollars a month comes to two cents a mile, and repairs certainly will mount up to another two cents on a car like yours. Throw in another half cent for oil and miscellaneous items and the

Gus and Joe Tell How a Log Book Can Help You Run Your Auto with More Efficiency

By MARTIN BUNN

total figures up to the flat sum of thirteen cents a mile. You'd kick like a steer if a railroad charged you that!

"Can you and the wife and kid live on thirty-five dollars a week? That's all you have left out of your salary if you spend about fifteen dollars a week on a car."

"Gee whiz! You sure are one cheerful guy, Joe!" croaked Baldwin dismally. "Well, what's the answer? Should I sell the bus as soon as I get it paid for?"

Joe scratched his head thoughtfully. "No," he said; "don't do that. It wouldn't help any now. The biggest depreciation comes the first year and if you have got along so far, I guess you'll make out without going to the poorhouse.

"If you'd asked my advice before you bought the car, I'd have told you to get a cheaper and lighter make—and that doesn't necessarily mean a flivver. What you can do, though, is to use the car a lot less than you do. Why, 'most every night I see you go by on your way to the stores for some errand. Lay off that errand stuff unless it's raining."

"Humph!" growled Gus as he jammed another load of tobacco in the bowl of his

(Continued on page 147)



Joe's simple car cost system consists of a plain record of mileage and the cost of gas, oil, tires, and all repair expenses

Keeping the "Log"

"Keep your notebook handy and whenever you buy gas or oil, or have a tube vulcanized or any repair work done, put down the cost of each item and the total of miles your speedometer shows"



Be Your Own Boss

Why keep on punching the time clock? Aren't you tired of taking orders from someone else? There's nothing like being in business for yourself!

Here's your big opportunity. Grasp it. Realize your ambition. Have a profitable business of your own. Be the Johnson Floor Expert in your community. Spring, the big season, is just ahead. Now is the time to get started. We will help you build your business.



Earn \$15 to \$25 a Day

*Be Independent!
Have a home of
your own—a bank
account. Enjoy
the comforts and
luxuries of life.*

As the Johnson Floor Expert you can make big money right from the start. There's a big demand for this service. Homes, clubs, hotels, stores, offices, schools and public buildings all want it.

You can go into any home, wax-polish all the floors in just a short time and not upset the rooms at all. It's the kind of service people appreciate—and it pays big profits! Mail coupon today for full information on the Johnson Floor Service Plan.

JOHNSON'S WAX *Electric floor Polisher*

This ingenious Electric Floor Polisher means success, independence, a business of your own. It wax-polishes any floor ten times faster and better than is possible any other way. Reaches under davenports, beds, buffets, desks, etc., without moving the furniture.

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Helpful Hints for Motorists

Simple Way to Rebush Kingpin, and Seven Other Useful Aids

IF THE kingpin bolt is allowed to get loose and the automobile is run for any great length of time with the bolt in that condition, the result is usually a worn lower bearing that makes refitting practically impossible. The only remedy is to drill out and rebush the hole. Figure 1 shows a novel way to use the weight of the car to feed the drill into the hole. The drill bit is fastened into an ordinary brace and the jack gradually is lowered. An even smoother feed can be obtained with one of the screw types of automobile jacks.



Fig. 1. Using weight of the car, controlled by a jack, to feed drill into hole for kingpin bolt

PART of the nuisance of washing the car is in coiling and uncoiling the hose. Again, the valve is usually some distance away from the place where the car is washed. Short of purchasing a swivel arrangement for an overhead supply, the simplest solution of the problem is to run a pipe up to the ceiling, put in a valve at a convenient point, and arrange a weight and cord to pull the hose out of the way when it is not in use. The arrangement is shown in Fig. 2. A 12-inch length of strap iron bolted to the handle of the valve and fitted with two cords will serve to turn the water on and off.

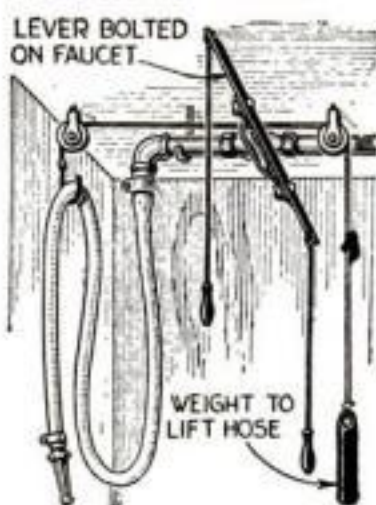


Fig. 2. Ingenious way of installing hose in garage for washing the motor car

IN MANY sections of the country the house water supply is not good for use in the radiator of an automobile because of a high mineral content that will be deposited, as the water is evaporated, in the radiator and the cylinder jacket. A scaly deposit of this type will interfere seriously with the proper cooling of the motor.

Rainwater is free from mineral matter and a barrel arranged as shown in Fig. 3 will insure an adequate supply. Rainwater can be used in storage batteries in place of the distilled water ordinarily sold for this purpose. Be sure to punch a small hole in the can that is attached to the pipe under the drain spout, so that, when it stops raining, the water in the can will run off and not form a breeding spot for mosquitos.

If you expect to use rainwater for storage batteries, construct the collector out of sheet lead and lead pipe and use lead pipe as a connection between the barrel and the hose.



Fig. 3. How to install a barrel in garage to supply rainwater for the radiator



Fig. 4. Three pieces of sheet metal bent to form lugs to support conveniently the extra tire

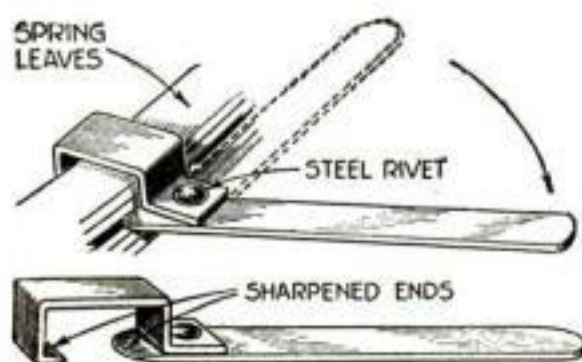
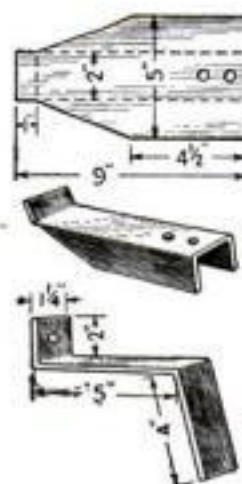


Fig. 6. Simple spring leaf spreader made of two pieces of spring leaves riveted together

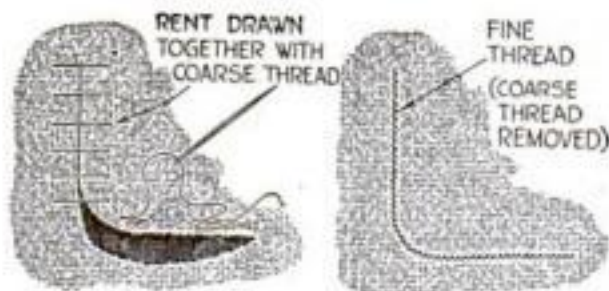


Fig. 5. Torn edges of upholstery can be pulled together with coarse thread, then sewed

ON LONG trips it is a great advantage to carry two spare tires. If the tires on your car are no longer new, you may reasonably expect several blowouts. Two blowouts may come in quick succession

and then the extra spare certainly will come in handy.

As shown in Fig. 4, three pieces of sheet metal are bent to form three lugs that will support the extra tire and rim. The two upper ones are riveted or bolted in place, while the lower one is fastened with a bolt so that it can be loosened up in order to allow the extra spare tire to be hooked over the two top lugs. Make sure, of course, that the framework of the tire carrier is strong enough to carry the extra load.

THE material used to upholster closed types of automobiles usually is stretched pretty tightly. When it is accidentally torn, the rent gapes open so much that it is difficult to sew up the tear in the ordinary way. A solution of the problem is to pull the torn edges together with coarse thread, then sew up the break with fine thread. Figure 5 shows you how to do this.

ALITTLE grease or heavy oil between the leaves of the springs always will make the car ride easier, especially if it is fitted with rebound snubbers or shock absorbers. Figure 6 shows how to make a simple spring leaf spreader out of two pieces of spring leaves. The spring leaves first should be annealed, then forged and filed and drilled for the rivet. After that, retemper them and rivet together.

IF YOU use your car in severe winter weather, you know that every little draft adds to your discomfort. Most of the cold air that makes winter driving uncomfortable comes in around the front curtains, where they are buttoned to the windshield.

A simple remedy for this trouble, which will help materially to keep the car warm, is to make a couple of shields of sheet aluminum, as shown in Fig. 7. These shields should be bolted to the windshield in such a way that they clamp the edge of the curtain tight against the windshield frame.

This inexpensive device can be made by any good workman and the extra comfort it will add to your car in winter weather will more than repay the outlay. Shutting out the draft also will lessen the danger of catching a cold—a consideration not to be neglected.

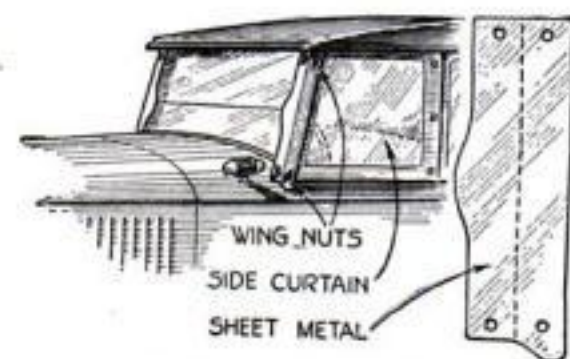
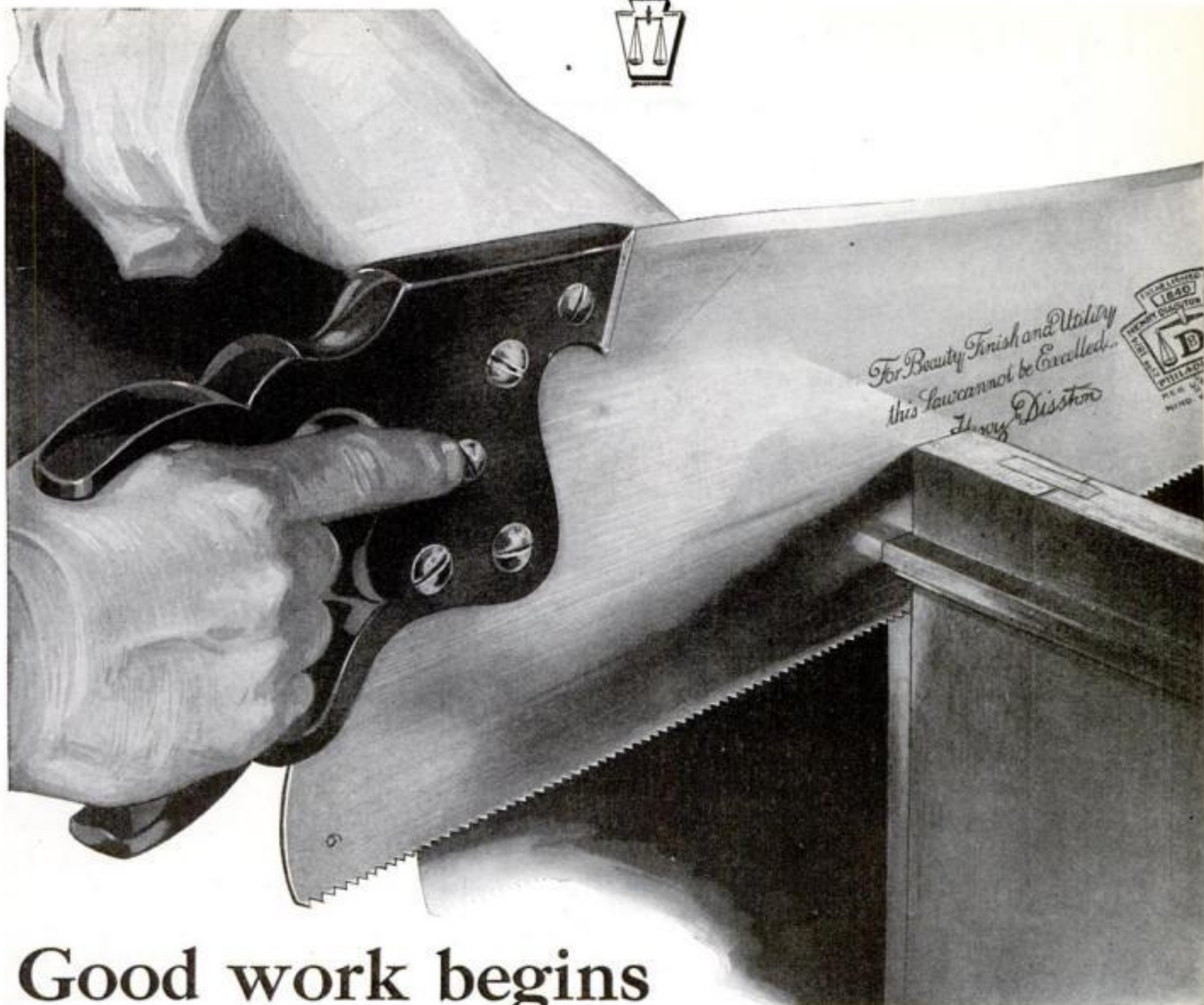


Fig. 7. Shields of sheet aluminum bolted to the windshield help keep the car warm



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NO man can turn out good work unless the sawing is well done.

⑤

And for good sawing, easy and fast and clean, you must have a saw that *cuts*.

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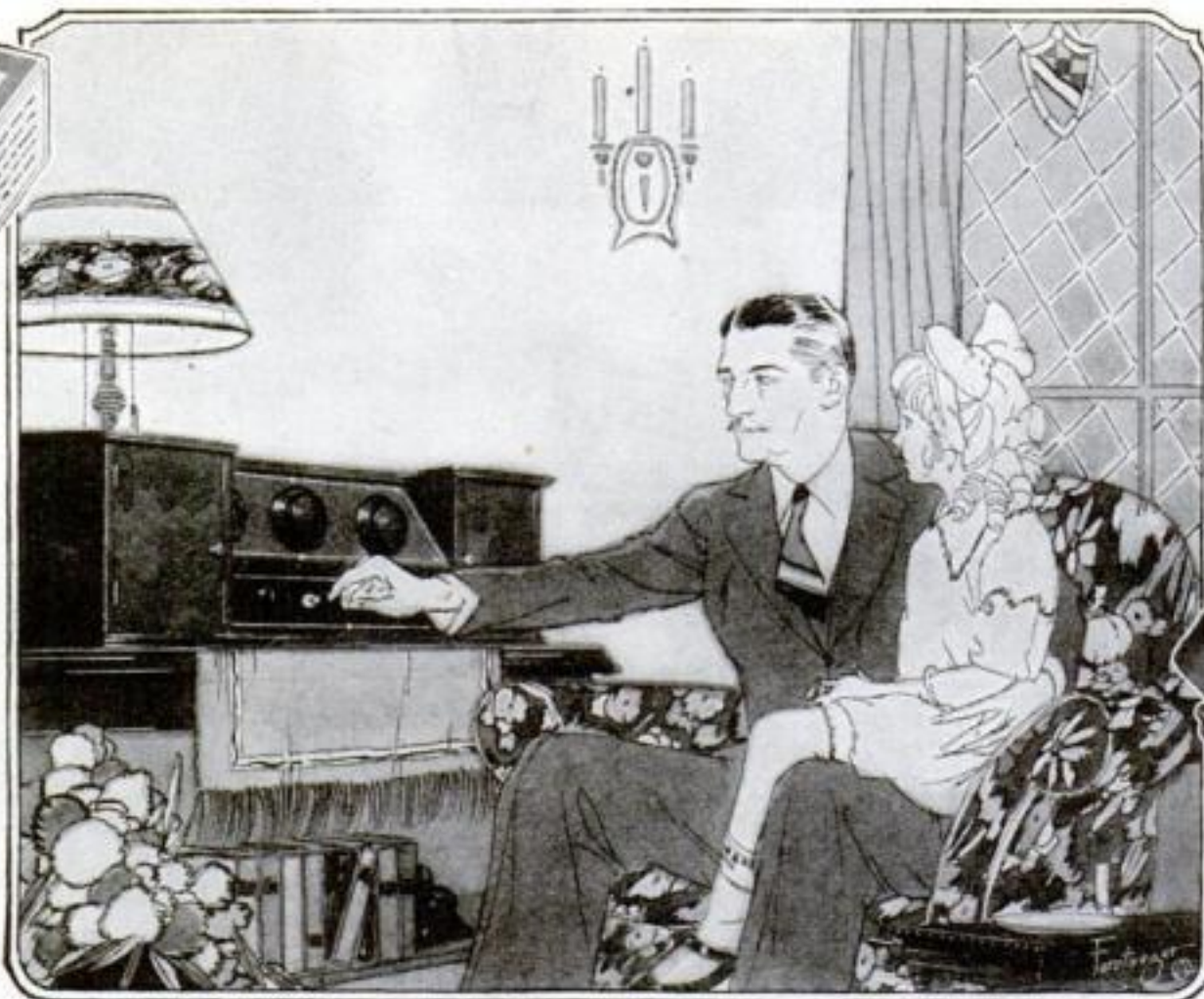
DISSTON

⑤ This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS, See page 6.



C-H Radioloc

The radio switch that locks with a key. Protects tubes and batteries against children and meddling adults. One hole mounting—quiet operation. Dustproof case. Two keys with every switch.



C-H Heavy Duty Radio Switch

More than a million in use. Preferred by both home set-builders and manufacturers. Many have imitated the knob, but no one can duplicate the patented "floating contactor" construction—the secret of its long life.



Thus More Than a Million Concerts Start Every Night

THE first panel mounting switch built exclusively for radio service? It carried the Cutler-Hammer trade mark.

The first radio switch that locked with a key to protect tubes and batteries from meddling fingers? It was designed by C-H engineers.

The first handy toggle type radio switch? Yes—it, too, was built by Cutler-Hammer.

Little wonder that they are found in more than a million sets today. For they were designed to render the trouble proof service for which they are now famous and their patented mechanism cannot be duplicated. Because they sell in such tremendous quantities their cost of production is remarkably low.

That explains why most radio fans build them into their sets, and why you find them on so many manufactured sets today.

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THE CUTLER-HAMMER MFG. CO.

Member Radio Section, Associated Manufacturers of Electrical Supplies
MILWAUKEE, WISCONSIN



C-H Radio Toggle Switch

The very popular toggle switch idea applied for the first time to radio. Beautiful appearance. "On" or "off" with a flip of the finger. Neatly etched plate to indicate position. Requires very little space back of panel. Contacts are broad and self-cleaning. Quiet operation. One hole mounting. Nickel finish.

A list of some of the prominent radio manufacturers using C-H Radio Switches

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American Bosch Magneto Co.
Argus Radio Corporation
Astral Radio Corporation
Chas. A. Branston Co.
Chelsea Radio Co.
Dayton Fan and Motor Co.
Freed-Eisemann Radio Corp.
Gilfillan Bros., Inc.
Howard Radio Co.
Malone-Lemmon Laboratories
Wm. J. Murdock
Robbins Radio Co.
Silver-Marshall Co.
R. E. Thompson Co., Inc.
Victoreen Radio Co.
Workrite Mfg. Co.

CUTLER-HAMMER

Radio Parts for Performance



The Home Workshop

Arthur Wakeling, Editor

A Ship Model of Your Own

How to Build a Picturesque Pirate Galley

By CAPT. E. ARMITAGE McCANN

CARAVELS and galleons here, there, and everywhere! Ship models are enjoying unprecedented popularity. Every one seems to wish a decorative ship model for his home, and competitive buying has forced the prices sky high.

Most of the models on the market are shipped here in hundred lots from Munich. They bear little resemblance to a ship and have no lasting interest, though many of them are quite ornamental. Then, too, models are being made all over the country by those who have little skill and less knowledge. None of these is, strictly speaking, a ship model, but may be regarded as decoration with a ship motif.

It would take a huge book to give all the details for making a real scale model of a frigate or clipper ship, and even if these were followed, the model would not be satisfactory unless the maker had a considerable skill and knowledge of ships.

To strike between these extremes the writer has designed what he will term a "sketch model" of an actual ship, which has been so simplified that any one can make it who has nimble fingers and a few simple tools. Little if any materials need to be bought.

The model is taken from the actual lines of a felucca or zebec, a class of ship with lateen sails used by the Barbary corsairs. In size and period it is between the galley rowed by oars and the square-rigged galleass of the seventeenth century. This general type of ship, especially when carrying several square as well as lateen sails, was known best as a

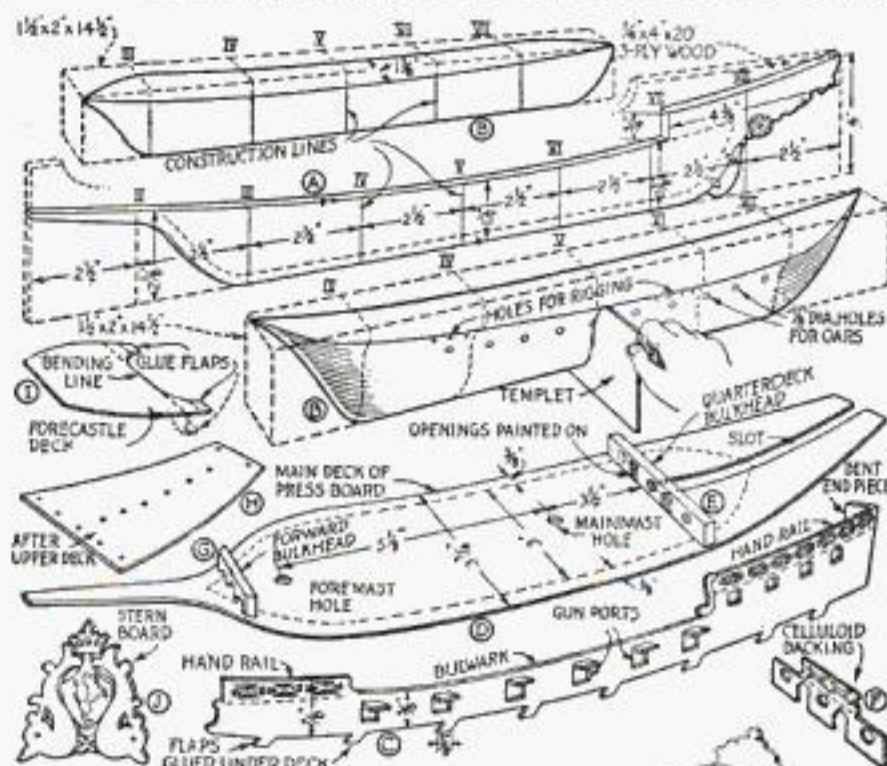


zebec (or xebec). It is much more graceful than the round galleons and can be at least as picturesque. It also has the great advantage that there are few other models

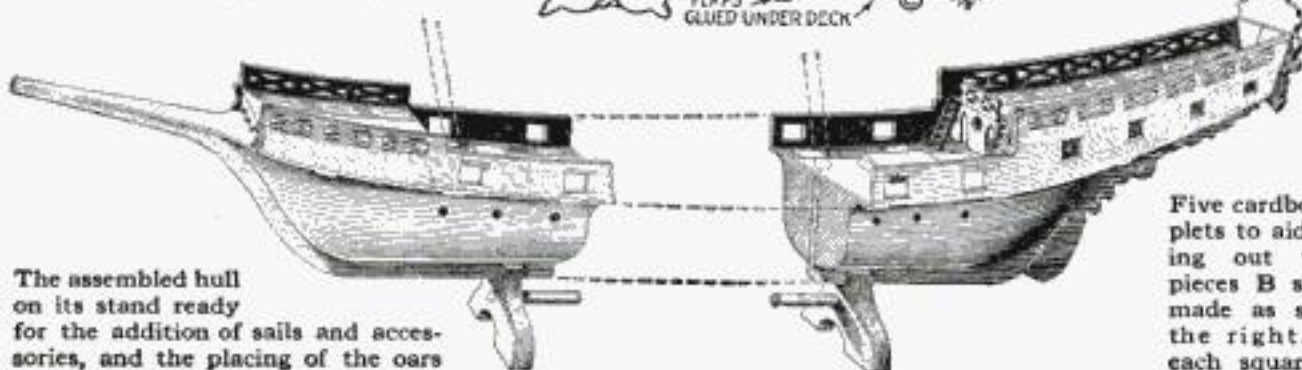
to be had that resemble it in the least.

Just stop for a moment, close your eyes, and imagine the dazzling blue brilliance of the Mediterranean Sea. A lateen rigged ship, gorgeous as a bird of Paradise, is skimming before the wind. Her sails are dyed scarlet at the tips and the red color runs like blood down into the golden yellow of the main canvas, fading into it through many shades of orange. Ten pairs of oars sparkle and flash in hurried cadence. A blue silk canopy embroidered in gold covers the afterdeck, beneath which, if you are close enough, you can see the pirate chief straining his eyes toward the

(Continued on page 96)

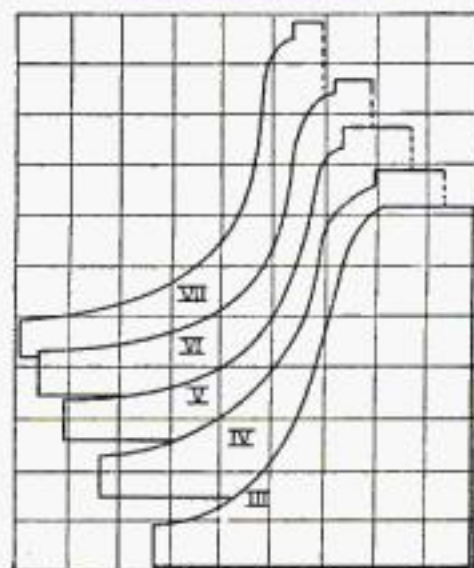


How the three hull pieces and the deck members are cut out is illustrated at the right. The hull is wood; the decks and rails are sturdy, flexible pressboard



The assembled hull on its stand ready for the addition of sails and accessories, and the placing of the oars

Five cardboard templates to aid in carving out the hull pieces B should be made as shown at the right. Make each square $\frac{1}{4}$ in.



Full size drawings of this picturesque felucca are contained in Home Workshop Blueprint 44. See page 95

My Methods of Enameling Furniture

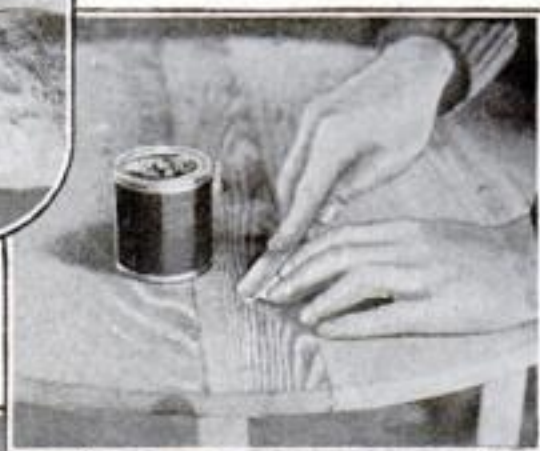
Preparing the Wood, Concealing Defects, Applying Undercoats and Enamel, and Giving Special Treatment to Old Pieces

By LAWRENCE B. ROBBINS



The first essential is to sandpaper the wood to a smooth and satiny finish. Use No. 1 sandpaper over a block and finish with No. 0. Then dust the surface thoroughly

OLD pieces of furniture that you may have relegated to the attic often can be made charmingly decorative with a little work in paints and enamels



Holes and cracks may be filled with light colored sealing wax or a shellac stick, or they may be puttied after the first priming coat has been applied to them



Any color may be had by mixing artist's oil colors on a sheet of glass with turpentine and adding the thin paste to the enamel



When cleaning up old pieces of furniture you can do much of the scraping with broken glass



Steel wool is useful for cleaning up old pieces, especially when they are irregularly shaped. The finest grade also is useful for removing the high gloss from enamel on any but the last coat, which should be rubbed with fine pumice stone and water

NOW that painted furniture is enjoying so great a vogue, practically every home worker has to undertake from time to time either the enameling of new pieces or the refinishing of old. The woodworking tools have to be banished temporarily, the bench top dusted off, the floor dampened and swept clean, and the little shop, whether it is in the attic, cellar, or garage, turned over entirely to the work of painting.

Indeed, the first, if not the most important point in enameling furniture, is to have a good place to work. The room must be as dust free as you possibly can make it. You should not even walk around unnecessarily while doing the enameling. At the same time the room must be kept warm—at least 70 degrees—and also well ventilated.

Perhaps you have one of the graceful but unfinished breakfast-room sets that now can be purchased in large variety, all ready for painting. Possibly the piece to be finished is one you have made—a kitchen cabinet, a sun-porch table, or something of that kind.

Whatever it is, if the wood is new, the first thing to do is to give the surface



Remove all metal handles and knobs before beginning work



An auto tire pump will blow dust from old wicker furniture

as smooth and satiny a finish as possible. Rub it first with No. 1 and then with No. 0 sandpaper.

If there are nail holes, cracks or some chipped places, these can be filled with light colored sealing wax; or, after the priming coat has been applied, you can fill them with a putty made by mixing a little of the flat undercoater with powdered whiting.

As close grained woods are used

nearly always for furniture that is to be painted, you will not have to fill the grain. If, by any chance, you are going to enamel and paint an open grained wood such as chestnut or oak, you will have first to fill the grain with a paste wood filler applied as directed on the can.

YOU will have to provide yourself, of course, with a sufficient amount of enamel of the desired color, an equal quantity of enamel undercoater or flat wall paint of a similar color, a 2½-in. beveled tip varnish brush of the best quality and, if the furniture has any small, intricate parts, a 1-in. brush as well. Turpentine is needed in case the undercoater or enamel has to

be thinned, and for cleaning the brushes. White shellac always is useful to have on hand, with denatured alcohol for thinning it. Sandpaper in sizes No. 1, 0, and 00 and, if obtainable, in a very fine size such as a 6-0, should be bought, as well as the finest grade of steel wool and a small quantity of powdered pumice stone and rotten stone.

Possibly an enamel of a little different

(Continued on page 100)



Enchanting Radio Nights for Everyone

Each night, when a myriad flashing lights make fairylands of the cities, a million folks tune in. Play-weary youngsters hear wonderful bed-time tales; light-footed boys and girls dance to the rhythmic music of fine orchestras, and their elders listen to great musicians and world-famous men. Winter nights no longer drag in Radio Homes.

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How to Insulate Your House

Gorman Tells His Neighbor the Secret of Saving Coal and Being Comfortable in Zero Weather—Blanketing Materials and Ways of Applying Them

By JAMES S. GODFREY

BRACING himself against the keen January wind, John Gorman paused a moment at the corner to wait for Marks, who was plodding through the snow from his home across the street. Both men were station-bound for the 7:53.

Marks made a grimace as he came alongside, a trifle winded by his haste through the soft, knee-deep drifts, and the men swung around the corner together.

"A bitter night, John! I never knew the house to feel so cold when I got up—b-rr!"

"It's cold all right," said Gorman; "but to tell you the truth, I didn't realize it until I came out and was nipped by the wind. It was warm enough inside."

"You must have some heating plant," commented Marks enviously as he glanced back across the vacant lots to their two houses. Something in the appearance of the buildings caught his attention and he looked again.

"You know, John, your house, for all that, looks a lot colder than mine from the outside."

"How is that?" inquired Gorman, as he stopped, ignoring the distant whistle of the train in his curiosity.

"Why the roof of your place is covered solidly with snow on this side, whereas most of the snow from yesterday's storm has melted off my roof."

"That's just it," laughed Gorman. "You are trying to heat all outdoors with your heating plant, while I have a roof that keeps the heat in. But we'll have to run!"

When they were settled in the smoking car, Gorman told how he had insisted that the builder of his house line the roof and walls with one of the standard wool-like, quilted insulating materials.

"It comes in rolls, something like building paper, only much thicker—like a layer of wool bound between two sheets of building paper. You might say the house is wrapped up in a blanket. That's why the snow doesn't melt very quickly on my roof. The roof doesn't get hot."

"But do you think enough heat to talk about gets out through that asphalt shingle roof of mine?"

"Enough! Why



they figure that 60 per cent of the heat lost in the average house goes out through the roof. I'm sure that with insulation you could cut in half the loss of heat through your roof."

"Yes, but you forget my house is already built," said Marks regretfully.

"What difference does that make?" demanded Gorman. "So far as the roof is concerned, you can apply the same insulation that I used, right under the roof between the rafters, because you have an unfinished attic. It is the simplest thing in the world to do. All that is necessary is to tack it up with furring pieces—any cheap strips of lumber—nailed against the rafters."

"If there is no floor in your attic, you can lay it right over the ceiling joists, which is a little easier to do. Or you can get certain soft, flexible materials in 17-inch widths, which are intended to be pressed in between joists laid on 16-inch centers. Then, if a floor is laid later on, you will have splendid insulation, because there will be in effect five layers—ceiling, air space, insulation, another air space, and flooring. Insulating materials should be applied, if possible, to inclose an air space or divide a wide air space into two."

"I always intended to lay a floor in the attic sooner or later," said Marks thoughtfully. "I've had the idea of fixing up the attic to make a spare room—you know, with wall-board."

"Well, then, why not use one of the special wall-boards intended to serve as an insulation? You can kill two birds with one stone that way. I have seen wall-board about three-eighths inch thick—I think it is made from cane shredded up and pressed together like felt—that is so good an insulator it is used in ice-boxes and refrigerator cars. The beauty of it is that it

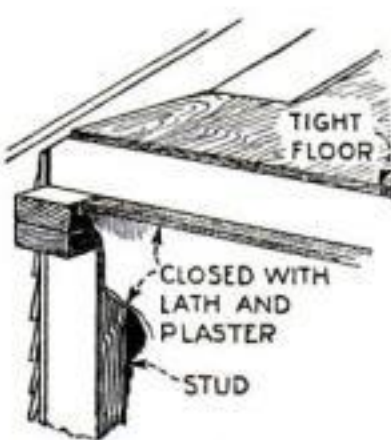
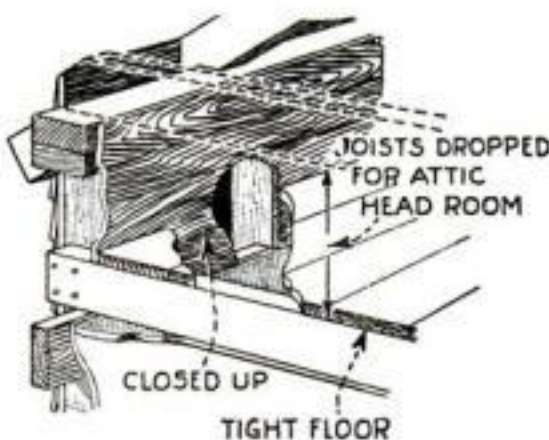
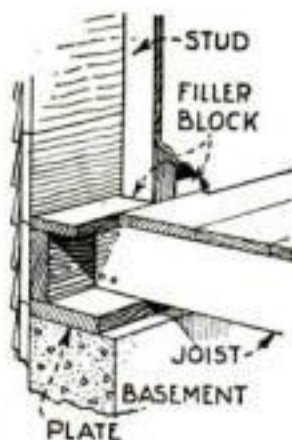
has a rather pleasing texture and can be stained or painted, or, if you want to go to the expense, plastered over. You can use something like that or, of course, you could put up the wool insulation right away and then at your convenience finish the job with ordinary wall-board."

"Do not overlook this fact—it is one that is generally misunderstood: There are no great differences between the respective insulating values of layers of equal thickness of the many insulating materials that are relatively light in weight compared with wood. So-called insulating materials, such as wallboards containing plaster or even those consisting of paper stock rather densely compressed, have little insulating value in themselves, but are, of course, valuable as structural members; they provide means for inclosing air spaces and add to the tightness of the wall construction."

"Another thing—the insulating value of a layer of material is strictly proportional to the thickness of the layer. Thin layers such as building paper or felt roofing have very little insulating value in themselves against conduction of heat, although they are, of course, necessary in many types of construction to prevent infiltration of air or water and consequent transfer or loss of heat."

"Don't overlook the fact that a large amount of heat often is lost by reason of air leakage around windows and floors, and, of course, also by direct transfer of heat through the glass. Weatherstripping and storm windows quickly pay

(Continued on page 154)



How to block wall openings at the foundation plate (at left); how to close up the openings between studs in an unfinished attic with wood or wallboard (center), and how to lay an attic floor (right)

TURN TO PAGE 80 FOR THE CONTINUATION OF THE HOME WORKSHOP DEPARTMENT



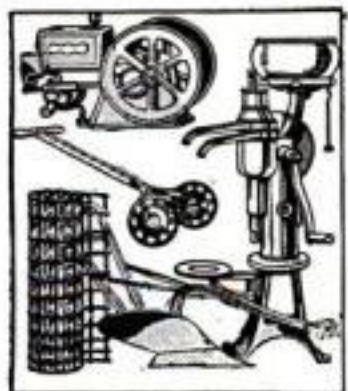
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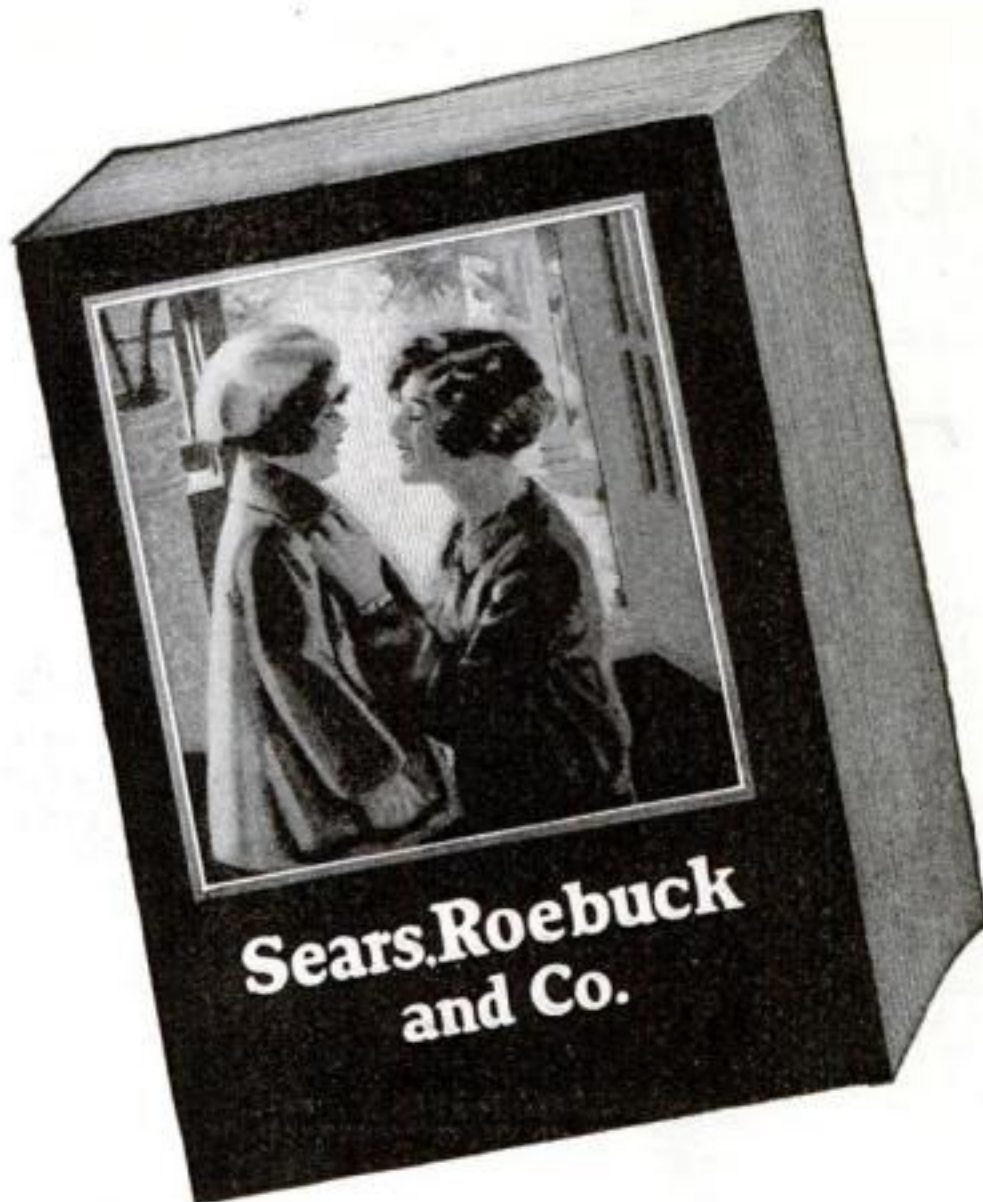
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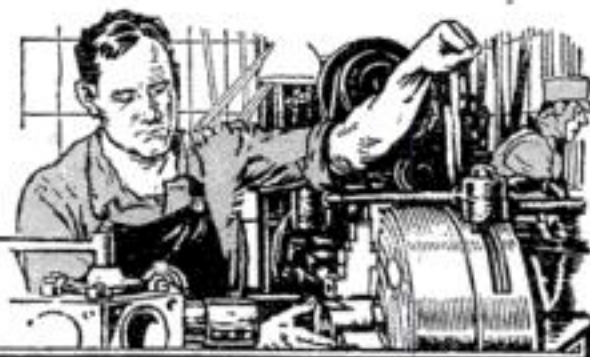
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Better Shop Methods

How Expert Mechanics Save Time and Labor



A Tale of Two Cranks

By JAMES ELLIS

JUST five minutes before the after-lunch whistle blew, and the entire personnel of Old Bill's shop was out sunning itself and recounting past experiences. Steve Burton, the blacksmith, had the floor.

"It was the slickest thing I ever saw," he stated with emphasis. "We had a crankshaft about thirty feet long—for one of the old river steamboats. It was a big thing; I guess twelve inches in diameter. The cranks at each end were shrunk on, and both of them had to be removed. I looked forward to a lot of hard and hot work slugging them off, but this fellow had something new to me that worked like a charm.

"He put the shaft in the fire, and heated both crank and shaft to a good red heat. Then, with no rush at all, he took the shaft out of the fire and lowered it on some heavy blocking. He took a hose and played water on the crank, cooling the outside first, until he had the crank cool. This seemed contrary to everything that I had ever heard about, but he cooled the shaft, and toward the last the stream of water would run between the crank and the shaft. When it was cool enough to touch, he had a couple of men sledge the crank off the shaft. The contraction of the cooling crank had compressed the shaft so that it was loose in the hole when both were cool."

"What would he have done if he had wanted to put the same crank back on the shaft?" one of the boys inquired.

"That was easy too. He calipered them and made a sheet iron shim, and shrunk them together again."

"This wizard on crankshafts ought to be here now," was the comment of a man who had come up at the tail end of the

discourse. "I have brought you one that is pretty much roughed up."

Old Bill and a couple of men went into the shop to see what the stranger had. It was a crankshaft from an oil engine. Something had gone wrong with the



crankpin oiling pipe and before any one knew what was going on, the shaft had been scored badly—so much so that one of the men thought it would make a good file.

Old Bill measured the shaft, which was 6 in. in diameter and about 8 in. throw, and gave orders to put it on the planer table. He looked around in that section of the toolroom where the paraphernalia for doing the exceptional job was kept and finally found two special false centers.

Bob Laten clamped these castings on the shaft and blocked it up so that the center line of the shaft and the pin were both parallel to and the same distance from the planer table. He drove a wooden plug into the center hole in each end of the shaft and located the exact center. With a surface gage he scribed a line across the chalked arms on the center line of the shaft. The throw of the crank apparently was 8 in., so he laid off on each of the arms a point 8 in. from the center of the shaft and on the line he had scribed. Using the electric drill he made center holes at these points.

They took the shaft to the shop's largest lathe, mounted it on the center holes Laten had just made, and bolted a piston casting to the faceplate to balance all that weight.

By the time that was done

Old Bill was back with a pair of long forged tools. They were long enough to reach to the pin while the cross slide cleared the cheeks of the crank.

"Do not try to take off very much," Old Bill said. "You will not have much trouble from chattering if you keep the tools very sharp. There is one for each side of the pin, so you can turn from the center toward each end."

When Laten had one of the tools in place, he turned the job over slowly to see how accurate his centering had been. He had missed it. Old Bill looked at the chip.

"Looks to be about a thirty-second off, Bob," he said. "Scrape centers over about that much and try again."

Laten soon had the pin running about as true as possible, and then carefully turned it off, taking a light chip first on one end and then the other until he had all the scored spots out. Then he took the best finishing cut he could and filed it off.

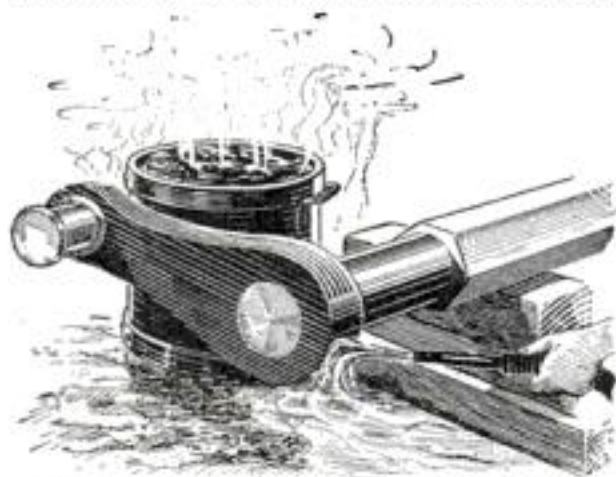
He had a block of wood sawed out to fit the pin to hold the emery cloth, and forced this against the revolving pin with a tool held in the toolpost, while he supplied it with oil.

Old Bill came around with the customer to inspect the job.

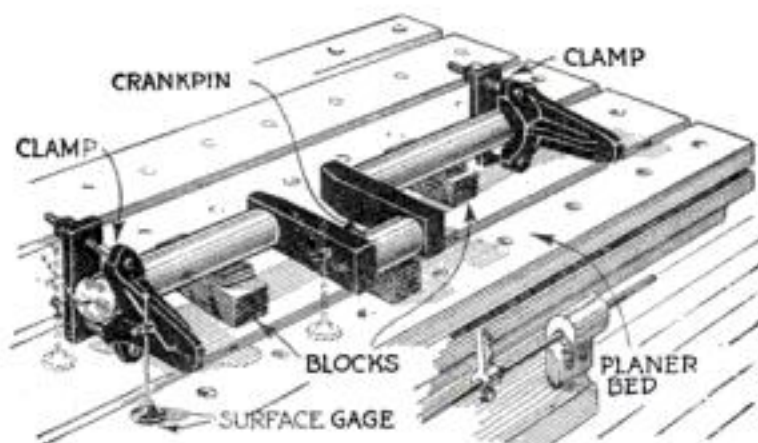
"We may not be wizards with crankshafts," he remarked; "but we know how to do a few things to them."

"I believe you have done as well as the factory," the customer exclaimed, as he felt the pin. "And it is a pleasure to know that a local shop can do that."

MANY time-saving shop ideas are contained in the continuation of the Better Shop Methods Department, which you will find on pages 108 to 122.



The crank was removed from the shaft by heating both and then cooling the crank first

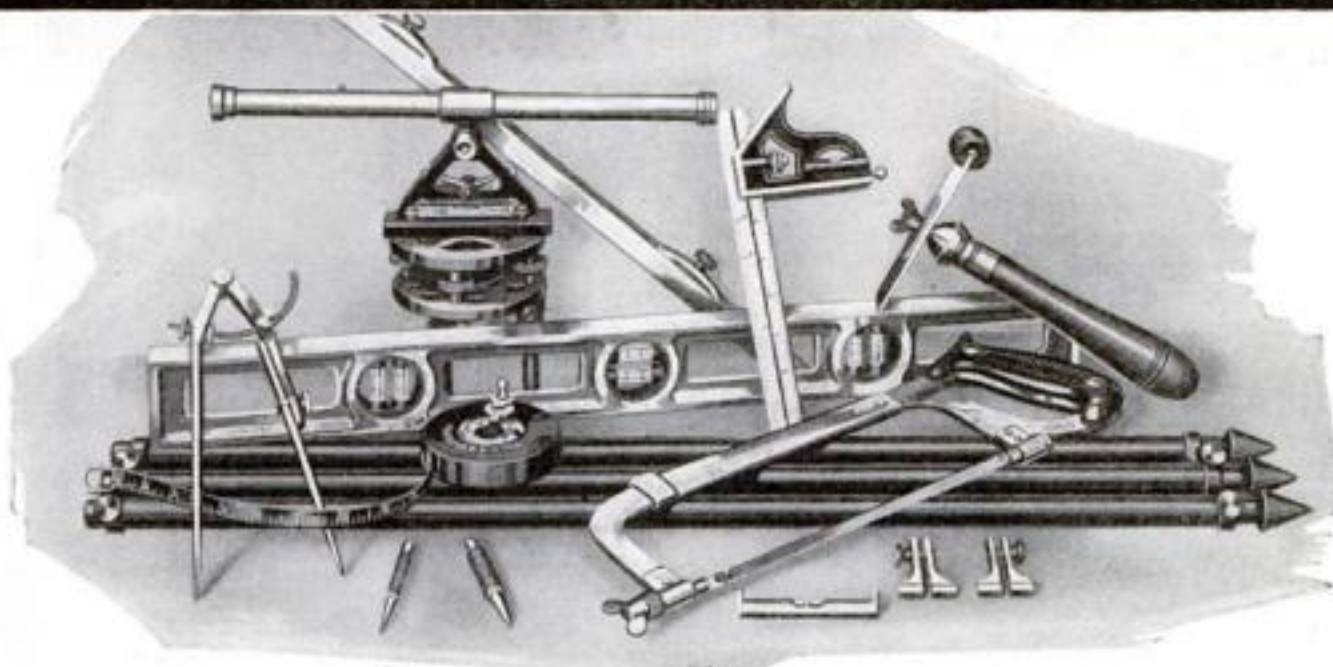


V-clamps were fastened to the ends of the crankshaft and it was blocked up so that the centers could be marked

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what I'm
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The Home Workshop

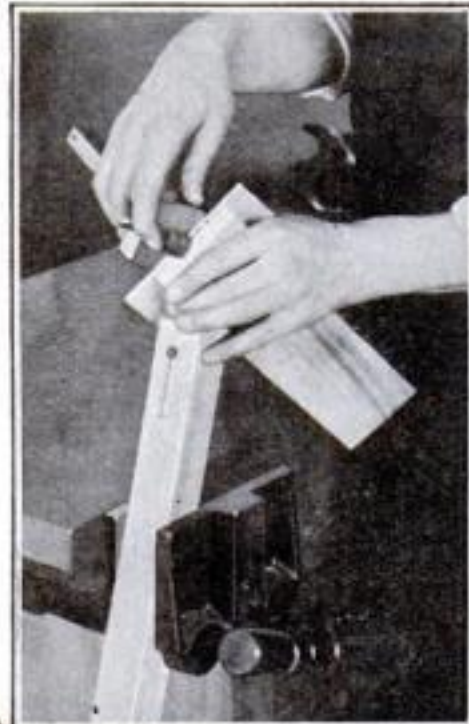
Cutting Mortises and Tenons

How to Make a Universally Useful Furniture Joint

By EMANUEL E. ERICSON, *Noted Manual-Training Authority*



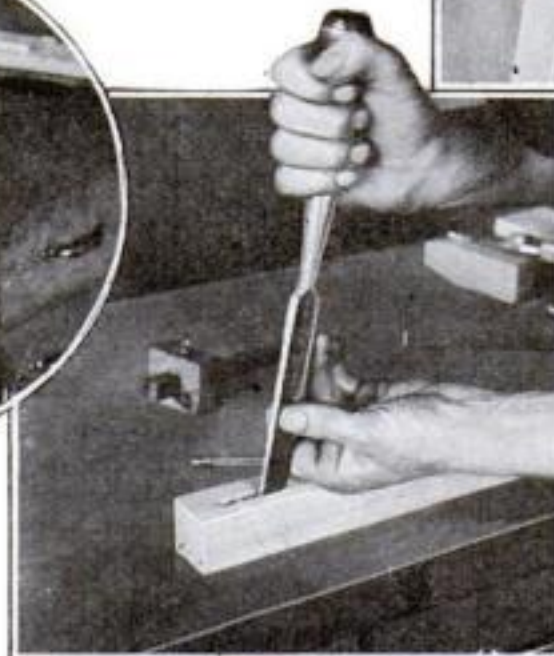
1 To lay out a joint for connecting a table leg and rail, first mark the limits of the mortise, which should be two-thirds or three-quarters the width of the rail



2 Set marking gage to locate mortise on leg. When marking rail, use thin piece of wood as shown to provide for desired offset. Mark the center of mortise as boring guide



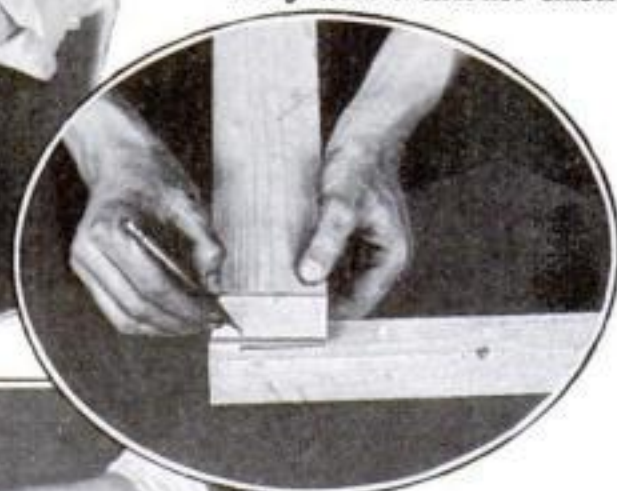
3 Bore holes close together along the mortise, using an auger bit the full size that the finished cut is to be. If no depth gage is at hand, make one from a block of wood



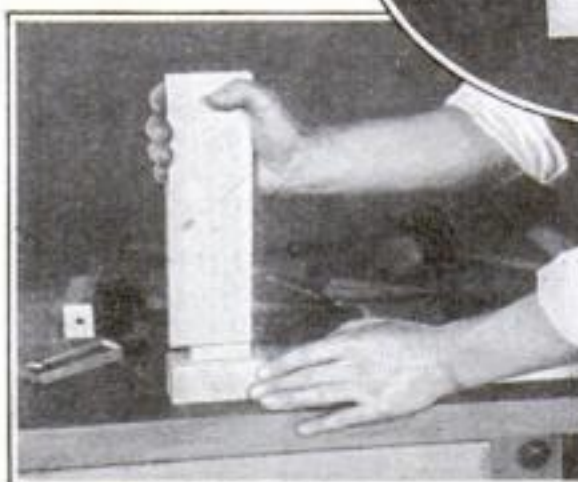
4 Next clean up the mortise with a wide chisel, tapping it with your hand or a mallet. Square up ends with a chisel of suitable width. Some mechanics cut mortises entirely with a mortise chisel



5 Cut tenon with a fine rip saw (six points or finer) and a backsaw or fine cross-cut saw



6 Mark the width the finished tenon is to be by holding it close to the mortise. Then use a marking gage or simply gage with a pencil held against the thumbnail. Remove surplus wood with rip saw and cross-cut saw



7 The finished joint should fit so that it can be put together by the pressure of the hands

Football player discovers new way to end foot pains—in 10 minutes

Specialists everywhere are urging it. Feet again become normal through natural means. Millions find it works wonders where all else has failed. Make the astonishing test explained below. It ends foot and leg pains in 10 minutes or costs you nothing.

FOR years scientists have sought ways to correct painful foot troubles. But it remained for an athlete and football star to find the most effective way of all. Through an accident in scrimmage has come a discovery that specialists say performs miracles.

When certain muscles weaken

The foot is composed of innumerable muscles, sensitive nerves and tiny bones.

The bones are arranged to form two arches. One is a hidden arch, few people know about, extending across the foot from the little to the big toes. The other extends along the foot from heel to toe composing the instep. It is the function of the muscles to hold the bones forming these arches in place.

Now, say the specialists, modern shoes, and other things too, cause the muscles to weaken. As a result the bones spread from over-strain and arches sag.

The forward arch falls first, throwing the entire foot structure out of balance. Then the instep breaks down and completely gives way. Bones crush delicate blood vessels and sensitive nerves. Pain becomes unbearable.

Science corrects misplacements.
Nature heals and strengthens.
Pains vanish like magic

Difficult as this might seem to correct, science has found a simple but astonishingly effective remedy. To strengthen the muscles exercise is necessary. So science provides a thin, strong, super-elastic band to assist the muscles in holding the bones in place. It takes the pressure off the nerves and helps nature strengthen the muscles through constant daily use. This band is the Jung Arch Brace. The secret of its success lies in

its correct tension, in its scientific contour and design.

Rigid supports merely offer temporary relief and tend to further weaken the muscles by supplanting their natural functions. But this soft pliable band can soon be discarded entirely, so quickly does it do its work. And from the instant you slip it on, you can dance, run, walk or stand without the slightest twinge of pain.

So light and thin is this band that it can be worn with the sheerest hose, the tightest and most stylish high-heeled shoes. Physicians say that it is the one scientific way to restore the natural structure of the foot. They urge you to make the test offered you here, without delay.

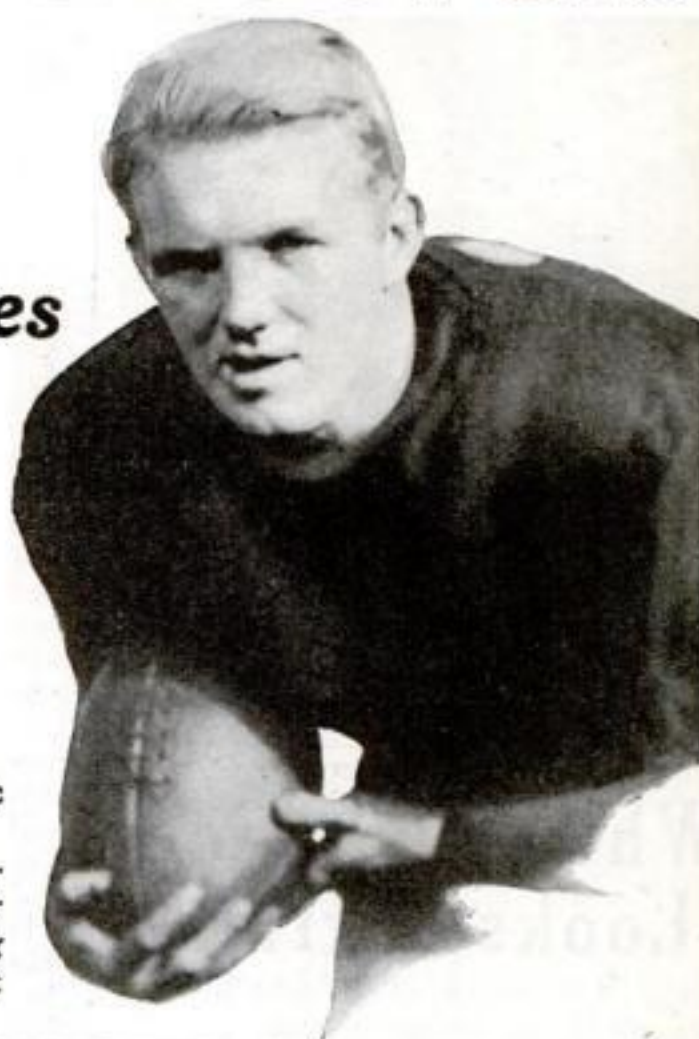
Make this amazing 10-minute test

Over a million men and women are enjoying normal, healthy feet as strong as an athlete's. Make the test that performed a miracle for them.

Go to any druggist, shoe dealer or chiropodist and be fitted with a pair of Jung Arch Braces. Wear them ten days. If not delighted with the instant and



JUNG'S
The "Original"
ARCH BRACES
End Foot Pains in 10 Minutes



End These Pains



Pains, aches or cramping in calf of leg and knee.



Pains or aches in ankle, heel, arch or instep.



Pains or cramps in toes, callouses on ball of foot, spreading causing bunions.

Other symptoms: Tired, aching, burning sensations. Shooting pains when stepping on uneven surfaces. Shoes feel uncomfortable and seem too small. Feet become sensitive.

lasting relief, take them back and every penny will be returned.

If your dealer hasn't them we will supply you. With a half inch strip of paper measure around the smallest part of your instep, where the forward edge of the brace is shown in the circle diagram.

Mail us this measure. We will send you a pair of Jung's Arch Braces ("Wonder" Style). Simply pay the postman \$1 and postage.

For people having long or thick feet, for stout people or in severe cases, we recommend our "Miracle" Style, extra wide, \$1.50. Wear them two weeks. If not delighted return them and we will send every penny back immediately.

WRITE FOR THIS FREE BOOK

Write to us for our free book, illustrated with X-ray views of feet. Tells all about the cause and correction of foot troubles. How to stop foot and leg pains.

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THE JUNG ARCH BRACE CO.,

232 Jung Building, Cincinnati, Ohio.

Please send me a pair of Jung Arch Braces in style checked.

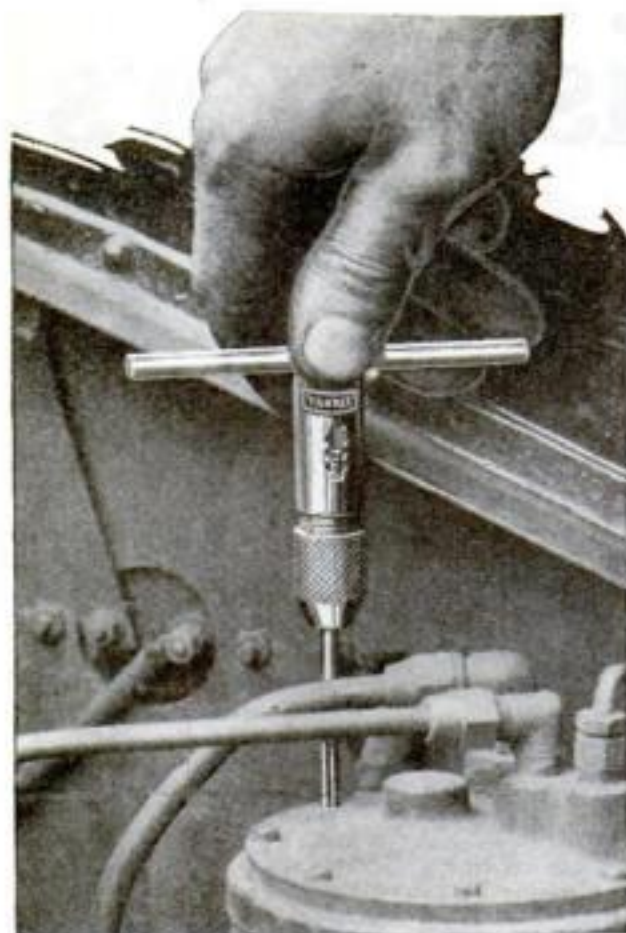
☐ Wonder Style, \$1.00 ☐ Miracle Style, \$1.50

I will pay postman the above price and postage. My money to be returned if not satisfied. I enclose foot measurement.

Name

Address

P. O. State



Where Tapping Looks Difficult

Here's a tapping job that looks difficult. A complete turn cannot be made. Something could be moved—that takes time.

But it's easy with a

"YANKEE"

Ratchet Tap Wrench

In this case, the mechanic simply set the Ratchet Shifter to give him right-hand ratchet.

Then, by turning the cross bar back and forth, he quickly finished the job.

No matter where the hole is you can tap it with this handy tool.

Three adjustments. Right-hand Ratchet, Left-hand Ratchet and Rigid. Knurled finger turn at top quickly starts or backs out taps.

No. 250—Length 3¼ in. Chuck diam., ¾ in. Holds up to ⅝ in. taps.

No. 251—Length 5 in. Chuck diam., ¾ in. Holds up to ⅝ in. taps.

No. 1251—Length 13 in. For jobs needing long reach. Otherwise same as No. 251.

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"YANKEE" TOOLS
Make Better Mechanics

The Home Workshop

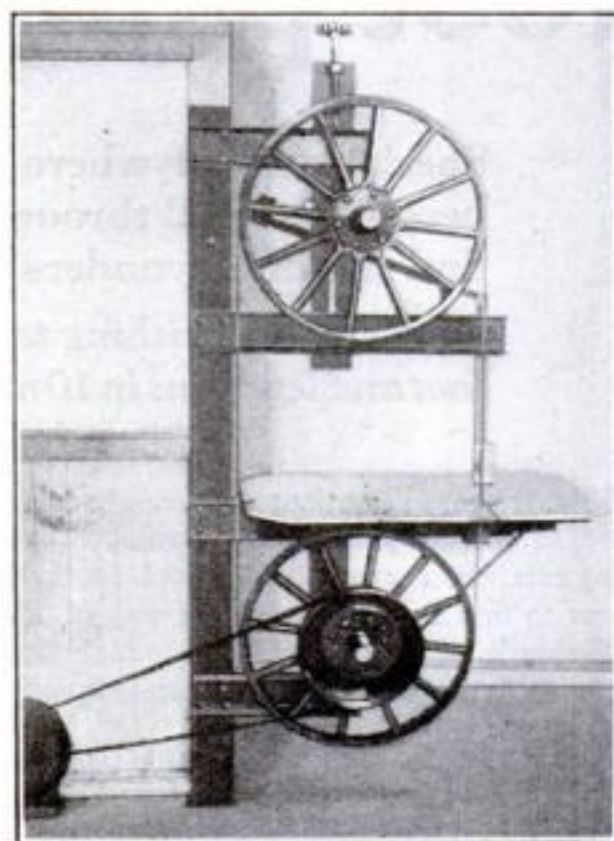
Ball-Bearing Bandsaw Built Mainly from Old Auto Parts

By RAY F. KUNS

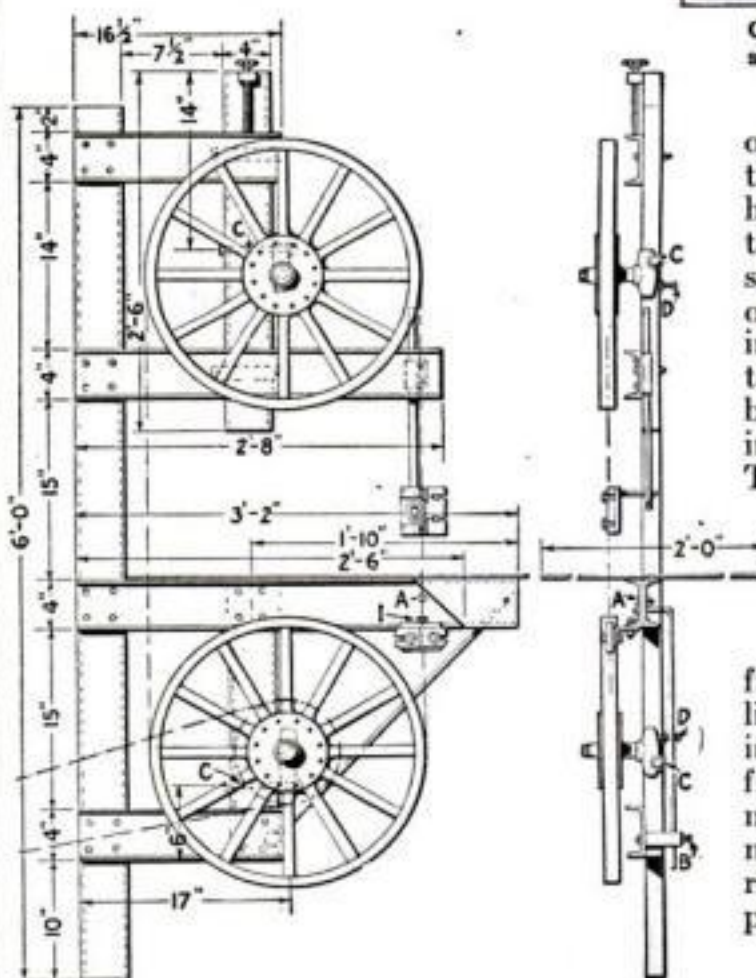
Principal, Automotive Trades School, Cincinnati, Ohio

IN DESIGNING a streamline body for an auto that was to be used for touring and camping, the problem of sawing out the curved timbers for the frame presented itself. While it was not impossible to work out the curved and irregularly shaped parts with ordinary hand tools, 2-in. oak is apt to take the edge off any home worker's enthusiasm. As there were heavy posts under the girders supporting the house, the idea of building a bandsaw on one of them suggested itself. Further thought discouraged this idea because the saw would not be portable in any measure and the wooden parts would lend themselves to every change of the atmosphere, so that the tool might get out of adjustment frequently.

It finally was decided to use 4-in. channel iron for the frame and then bolt the frame to the post in the basement of the house that housed the home workshop and that was near the garage where the automobile body was to be constructed.



One of four light-duty bandsaws constructed according to the details below

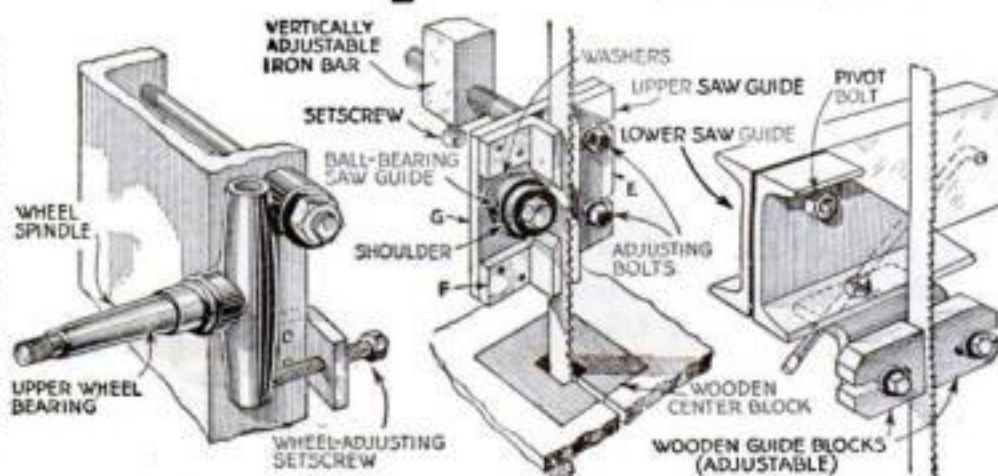


When the first saw was placed in operation it proved so popular that the plans were passed along until four had been finished. The one shown in the photo is the third one to be constructed. This varies a bit from the original plans in the method of locking the sliding member that carries the upper wheel. Otherwise the builders all followed closely the original plan as given in the drawing. The selection of wheels and spindles for the saw will have a minor influence on the details of construction.

As a matter of fact, the saw frame was designed to use Ford front wheels and spindles. These are light and, being carried on ball bearings, are free from power-consuming friction. The saws are driven by means of quarter-horsepower electric motors. Planks 12 ft. long have been ripped with ease. If a half-horsepower motor were available, the

(Continued on page 83)

The side and front views are shown above; details of wheel bearings and the upper and lower guides are given at the right. The sizes and type of parts available will influence the design to some extent. The saw shown makes use of Ford front wheels and spindles



The Home Workshop

Ball-Bearing Bandsaw

(Continued from page 82)

power and speed would be better, of course, since the saw could be speeded up, but the smaller motor, arranged to drive the saw wheels about 350 revolutions a minute, is quite satisfactory.

When planning a saw on the general lines of the one illustrated, first select the spindles and wheels. Strip the clincher rim or steel felloe from the wood felloe and glue soft wood plugs in all holes. The wheels then are laid aside until the frame is completed, when they are mounted and trued up by being turned in their normal position. This is done by using a C-clamp to hold a piece of wood at the center in front of the wheel and cutting the wood with a round-nose scraping tool. Give the surface a slight crown such as would be provided on a belt-driven pulley. It should be noted that the ends of the two halves of the wooden felloes are held together with a steel plate. The bolts that hold this plate have countersunk heads.

THE construction of the frame is comparatively simple. A 20-ft. length of 4-in. channel iron will provide enough material for the entire frame. This is cut to the lengths indicated, and drilled and bolted with $\frac{3}{16}$ by 1 in. capscrews and nuts. The flat surfaces are bolted together, face to face. This throws the channel section toward the post for mounting, so that the machine may be fastened to a round steel post as well as to a flat surface. Two of these saws were bolted to studding in an outside shop, one to a wooden post and the other to a steel pipe post. In the latter case the entire saw can be turned about the post when required by the work.

A tilting table is provided. This means that the arm supporting the table must be cut at about 45 deg. and a second piece of the channel bolted with a single bolt, face to face with it, to carry the front and tilting table. The closer this bolt, marked A, is held to the table top, the less trouble will be encountered in tilting the top.

The top is made from two plates of $\frac{1}{4}$ -in. steel. At the point where the saw is to pass through the forward plate, a saw cut is run in and a hole is worked out to take a 4-in. wooden block. This prevents damage to the saw blade when it accidentally strikes the edge of the 1-in. hole through which it passes. A bar of $\frac{1}{2}$ -in.-round cold-rolled rod is used to support the outer edge of the table in any desired position. It is locked by means of setscrew B. The rear part of the table is screwed directly to the table arm.

THE member of the frame carrying the upper wheel is arranged to slide up and down. A screw acts as a lifting device. In the saw shown in the photo two slots are cut in the face of the channel and single bolts used to clamp this member to the cross arms. In the drawing, plates and bolts are used for the same purpose.

The spindles are bolted to the carrying members with bolts C, made to fit the holes that originally carried the steering

(Continued on page 91)



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We believe it will give you shaving comforts unknown to you before. That it will surpass your present method of shaving in five important ways.

In your interest and in ours, let us send you a 10-day tube to try. We know we can win you in this way. 80% of its present users thus were won from other preparations.

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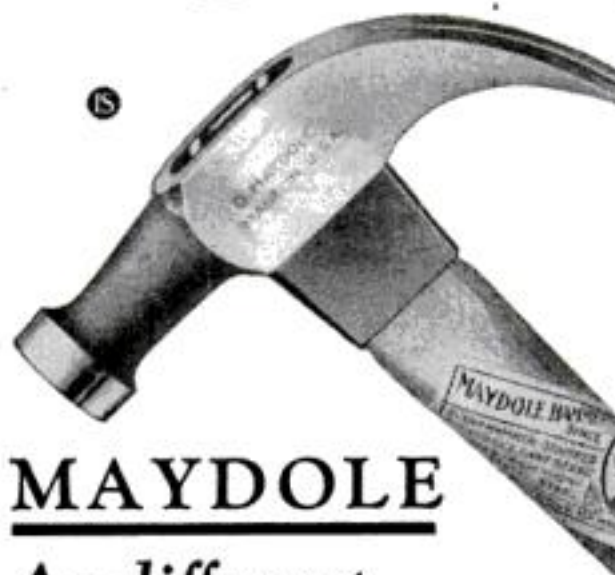


10 SHAVES FREE
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Simply insert your name and address and mail to Dept. B-1115, The Palmolive Company (Del. Corp.), 3702 Iron Street, Chicago, Ill. Residents of Wisconsin should address The Palmolive Company (Wis. Corp.), Milwaukee, Wis.



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**Maydole
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The Home Workshop

Uniquely Simple Radio Cabinet Requires Little Skill to Build

By NORMAN C. TOCK

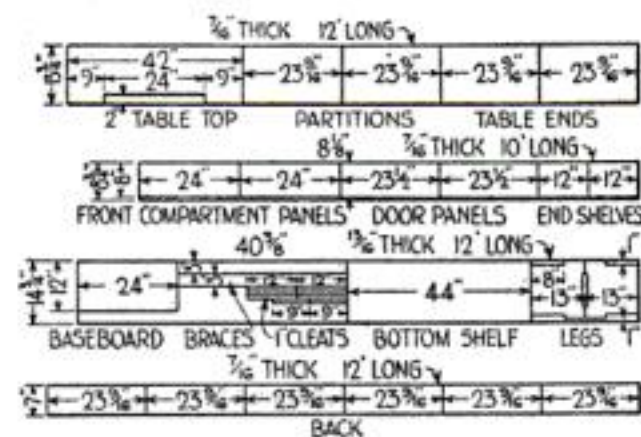
RADIO fans who are looking for ideas in cabinets will find several features to recommend the one illustrated—simplicity of construction, economy in wood, and general serviceability.

The basic design can be made as ornamental as one wishes by giving the legs a graceful contour, molding the edges, and applying overlays, moldings, or carved or gesso-work ornamentation. The dimensions can be altered to suit the size of the radio panel, without spoiling the appearance of the finished cabinet. For instance, if a 21-in. panel is to be used, subtract 3 in. from the indicated length of all horizontal members. To use a wider panel, decrease the height of the lower central compartment.

There is room in the compartment for a low, compact type of loudspeaker, a storage battery, B battery, charger, phones, tools, and the like.

White pine or butternut wood works easily and finishes well. Hard woods, such as walnut or oak, are more difficult to handle, but will make a better looking cabinet.

Four boards, each surfaced on both sides, should be purchased as follows: 1 piece $\frac{5}{8}$ by 8 in. by 12 ft., 1 piece $\frac{5}{8}$ by 9 in. by 10 ft., 1 piece $\frac{5}{8}$ by 14 in. by 12



ft., 1 piece 1 by 15 in. by 12 ft.

A study of the drawings will show the worker where any stray boards around the house can be substituted for the more expensive lumber listed. The back especially might be made from wallboard or from boxes.

The lumber, as surfaced at the mill, is thinner than the sizes called for. For instance, the 1-in. stock is only $\frac{3}{4}$ in. thick, and the $\frac{5}{8}$ -in. lumber, $\frac{3}{8}$ in. thick. The bill of materials on page 85 gives the finished thicknesses.

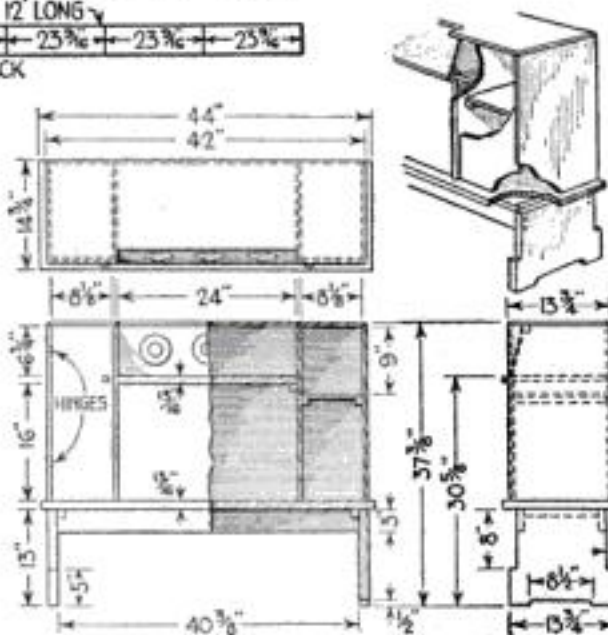


The cabinet reduced to its simplest terms with all straight cuts. Curved leg profiles, moldings, and other ornamental features can be added.

In sawing out these pieces, allow as much at the ends and sides as your skill with a plane makes necessary. As a rule it is enough to allow $\frac{1}{8}$ in. in length and $\frac{3}{8}$ in. in width to be taken off with the plane in the process of squaring up the boards. With a square and a pencil mark out your boards very carefully according to the plan. Saw as true to your line as you can. This will save trouble in planing.

Plane each board to the finished size and see that all edges and ends are square. Then mark out the part to be removed from the top of the cabinet, using a knife and try-square across the grain and a gage or a straightedge and pencil with the grain. Be sure to get the opening exactly the right length. Saw across the grain and cut along the other line with a chisel to get out the material. A rasp may be needed to smooth the edges.

Both legs are marked as a unit in the same way. Score a line across the center of the piece and 3 in. from each end of this line bore a 1-in. hole. Draw two parallel lines just touching the circumference of both bored holes and remove the material between them with a small hand-saw, keyhole, coping or turning saw. Even a chisel can be used if you are careful and know how. Smooth the edges with a rasp. Bore eight small holes for the screws $\frac{3}{8}$ in. from the side of the leg and $\frac{1}{2}$ and $2\frac{1}{2}$ in., respectively, from the top of the leg.



The upper diagram shows how the various parts are laid out and cut from four boards. The lower views illustrate concisely the very simple method of assembly and construction.

(Continued on page 85)

The Home Workshop

Simple Radio Cabinet

(Continued from page 84)

Assemble the leg unit by screwing the legs to the braces with 2-in. screws, No. 9 or 10, and screw the 9-in. cleats on the inside of the legs with their surfaces flush with the top of the leg. Use 1 1/4-in. screws, No. 8 or 9.

Screw the shelf cleats to the proper places on the partitions and sides with 1-in. screws, No. 9 or 10. Save room at front and back for the front and back panels.

Nail the partitions to the front panel with threepenny finishing nails. Keep the bottom edges even and set the panel back 1/4 in. from the edge. Use plenty of nails and set them well into the wood. These nails will not show.

Mark the location of the partitions and ends on the baseboard. The ends will center 1 3/4 in. from the ends of the base, and the partitions will center 9 3/4 in. from the ends. Mark these center lines care-

Bill of Materials for a Radio Cabinet

The finished size of the pieces are as follows, all dimensions being in inches:

Parts	Pieces	T.	W.	L.
Ends and partitions	4	1 1/4	13 3/4	23 1/4
Doors	2	1 1/4	8 1/2	23 1/2
Top	1	1 1/4	13 3/4	42
Front center	2	1 1/4	8	24
Shelves	2	1 1/4	8 1/2	12
Back	6	1 1/4	7	23 1/4
Legs	1	1 1/4	13 3/4	26
Bottom	1	1 1/4	14 3/4	44
Apparatus board	1	1 1/4	12	23 3/4
Cleats for base	2	1 1/4	1	9
Cleats for shelves	6	1 1/4	1	12

fully with a try-square and pencil and bore screw holes along them.

An easy way to attach the uprights is to lay the center section on the floor, back down, and screw the baseboard first to the partitions and then to the ends. Without lifting the cabinet from the floor, nail the top, which should be marked to locate centers of partitions, to the partitions and ends. Set the nails with a small nailset. Later the holes will be filled with filler or stick shellac.

The back can be fastened in with nails or lightly toenailed to base and top. The doors are fastened with small hinges, 1 by 3/4 in. being a good size. Set them back 1/4 in. from the front edge.

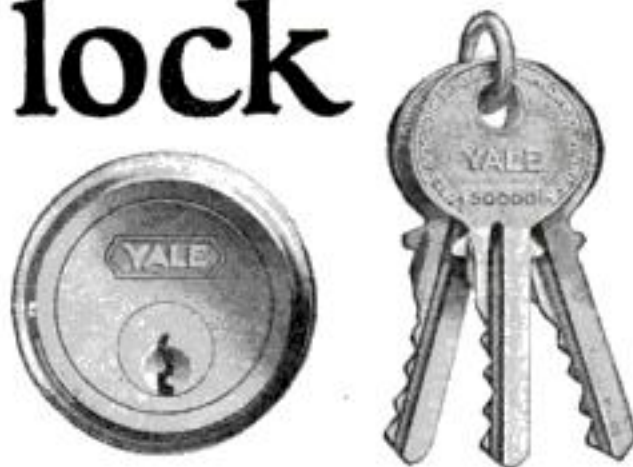
Most radio men like to use shellac rather than varnish for finishing cabinets. No filler is used under the shellac, but the wood may be stained as desired. Apply a coat of well thinned shellac, using a rapid brush stroke and avoiding any tendency to brush over a surface once it has been covered with shellac. The less brushing one does on shellac the better.

After this coat dries, which will be in three or four hours, sandpaper with very fine sandpaper. Apply a second coat, but allow the second coat to dry at least six hours. The third coat should dry 12 hours before sanding. Four coats of shellac should be sufficient.

If you use varnish, first stain the wood and apply a coat of paste filler if the wood

(Continued on page 94)

When you see the name **YALE** on the outside of a lock



you will have true dependable Yale construction inside

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The Home Workshop

How to Apply Wooden Trim on Door and Window Frames

By EDWIN M. LOVE, Craftsman and Specialist in Woodworking Methods

IT IS not necessary to have read the preceding five articles in Mr. Love's series on refinishing an attic room to profit by the many valuable hints on interior woodwork contained in this, the sixth consecutive article.



the jamb, and scribe the lower end to the stool. Do likewise with the other side casings and the mullion. Hold each in place, and by means of a rule held against the upper jamb, mark the height of the opening. Add $\frac{1}{4}$ in. and saw off square.

If, when held in place, the casings do not make

tight joints with the jambs, hollow them slightly on the backs. Nail them up with sixpenny finishing nails on the jamb edges and eightpenny at the backs, putting the latter opposite the former to avoid opening the joint, and setting the jamb nails last for the same reason.

Bevel the back edge of the neck mold a little, and work a molding on each end to match the front. Nail to the upper ends of the casings. Cut the head casing exactly as long as the width of the window from outside to outside edges of the casings and nail in place, toenailing the ends and center firmly against the neck mold. Drive one or two fourpenny finishing nails through the neck mold into the head casing, holding it firmly against the jamb the while, and nail back the lower edge of the head casing, which

(Continued on page 87)

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ATKINS SILVER STEEL SAWS

AFTER the boards and moldings for the finishing trim have been cut to rough lengths and cleaned up, the work of installing it will prove to be the most interesting and enjoyable part of the fitting up of an attic room.

The window stool is notched around the jambs to such depth that the rabbeted shoulder fits snugly against the sill. The simplest way to do this is to support the stool on a block tacked to the sill under the mullion. Then set scribes or dividers to the width between the sill and the rabbet, and scribe both ends of the sill to the walls, and the center and ends to the jamb edges. Press a rule against the jamb faces to mark for the cuts across the grain.

Rip the ends, undercutting slightly to insure a contact at the top, and chisel out the mullion notch after the cross cuts are made. The end projection beyond the casings must equal the front projection.

Try the stool for a fit, making necessary corrections, and work returns on the ends to match the molding along the front edge. Rip and joint the rabbeted portion to a 1-in. width and bevel the upper edge $\frac{1}{2}$ in. back, as shown in the section. Place the stool and drive three eightpenny finishing nails in each opening. Fit a piece of stop to the slope of the sill, giving it a projection of $\frac{3}{8}$ in. above the stool, and nail it solidly to the stool edge.

Gage a pencil line around the edges of the jambs $\frac{1}{4}$ in. from the faces, as guides for the casings. Stand a side casing on the stool with the face edge flush with



Marking the height of one side of a door casing

"Craftsman" finish with butt-jointed casings and mitered back band

The Home Workshop

How to Apply Wooden Trim

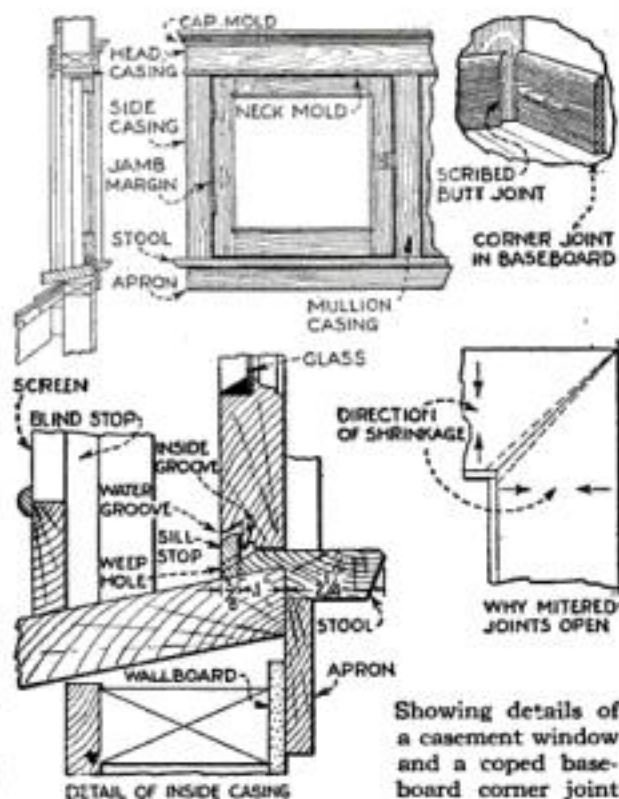
(Continued from page 86)

should draw the neck mold firmly against the jamb.

The apron is usually $\frac{5}{8}$ -in. stuff. Cut to the length of the upper casing, bevel the upper edge slightly, and nail in place while prying upward against it with a lever, or spring a stick between it and the floor. Since the window is high, this joint should be fitted neatly.

Remove the casement sash and cut off the bottom to the correct length after measuring the distance carefully with a rod. Rip out a rabbet on the outer edge, making the outer shoulder slope to drip the water. It should just clear the stool stop.

Just inside the outer edge of the long shoulder cut another saw kerf, or, better still, a groove $\frac{1}{4}$ in. wide and deep, form-



Showing details of a casement window and a coped baseboard corner joint

ing a secondary drip. Hang the casement with parliament butts placed 4 and 5 in. from top and bottom respectively. Bore three $\frac{1}{8}$ -in. holes at the bottom of the stool trough through the stop to allow any water that may drip there from the casement to flow off.

Case the doors in the same way. If molded casings are used, the joints ordinarily must be mitered. But all mitered joints, with the exception of those made in well seasoned quartered oak or some other non-shrinking hard wood, will open up as illustrated after a few months or years, because of shrinkage of the wood across the grain. If redwood is used, the whole joint opens up, as it shrinks lengthwise of the grain.

The "craftsman" style, a sort of false miter, consists of a butt joint between casings and a back mold that runs around the casings, giving a molded effect and hiding the end grain of the head casing. This requires careful joint fittings and may open a little when the head casing shrinks.

By delaying until this time the putting down of baseboards, they are spared many kicks and knocks. Cope the corner

(Continued on page 88)



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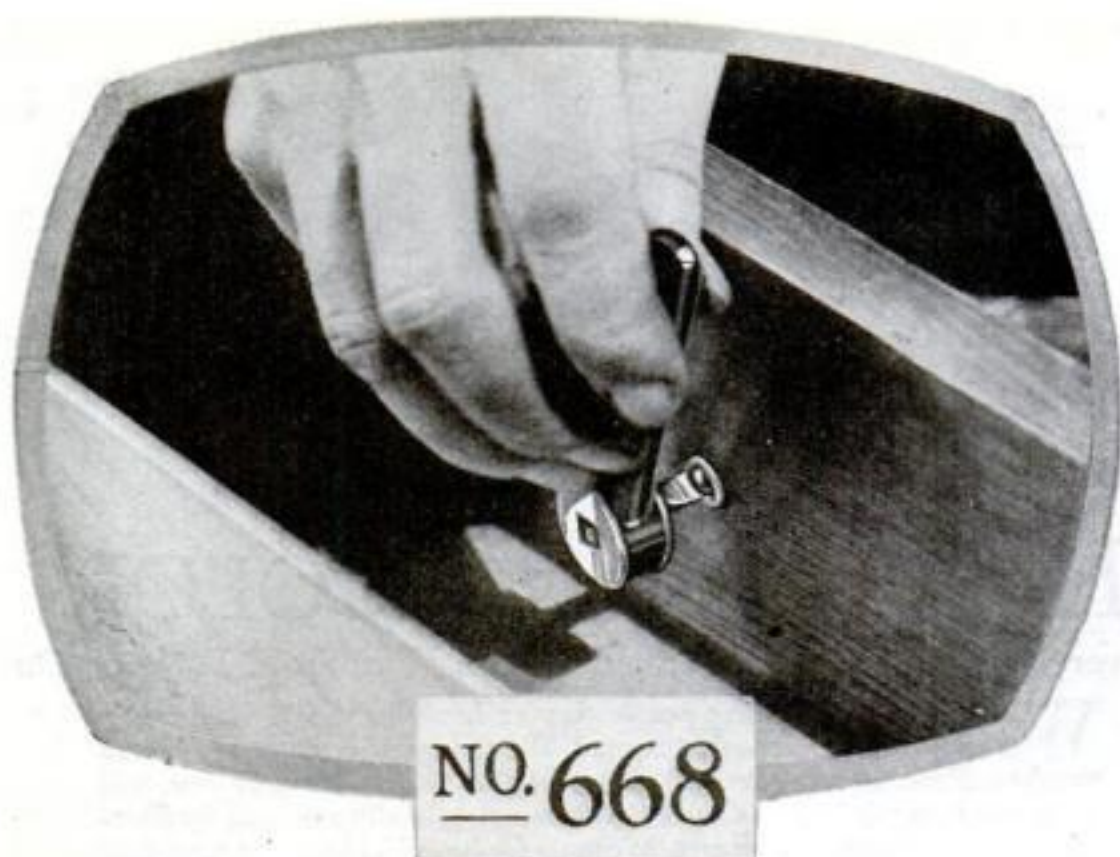
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AUTOMOBILE TOPS AND SEATS.....	S-W Auto Top and S-W Auto Seat Dressing			
BRICK.....	SWP House Paint S-W Concrete Wall Finish			Old Dutch Enamel
CEILINGS, Interior....	Flat-Tone	Scar-Not Varnish	S-W Handcraft Stain Floorlac	Enameloid
Exterior....	SWP House Paint	Rexpar Varnish	S-W Oil Stain	Old Dutch Enamel
CONCRETE.....	S-W Concrete Wall Finish			
DOORS, Interior.....	SWP House Paint	Scar-Not Varnish Velvet Finish No. 1044	Floorlac S-W Handcraft Stain	Enameloid
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FENCES.....	SWP House Paint Metallic S-W Roof and Bridge Paint		S-W Preservative Shingle Stain	
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Porch.....	S-W Porch and Deck Paint			
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ROOFS, Shingle.....	S-W Roof and Bridge Paint		S-W Preservative Shingle Stain	
Metal.....	Metallic Ebony			
Composition.....				
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TOYS.....	S-W Family Paint	Rexpar Varnish	Floorlac	Enameloid
WALLS, Interior (Plaster or Wallboard)	Flat-Tone SWP House Paint			Old Dutch Enamel Enameloid
WICKER.....	Enameloid	Rexpar Varnish	Floorlac	Old Dutch Enamel
WOODWORK Interior.....	SWP House Paint Flat-Tone	Scar-Not Varnish Velvet Finish No. 1044	S-W Handcraft Stain S-W Oil Stain Floorlac	Old Dutch Enamel Enameloid

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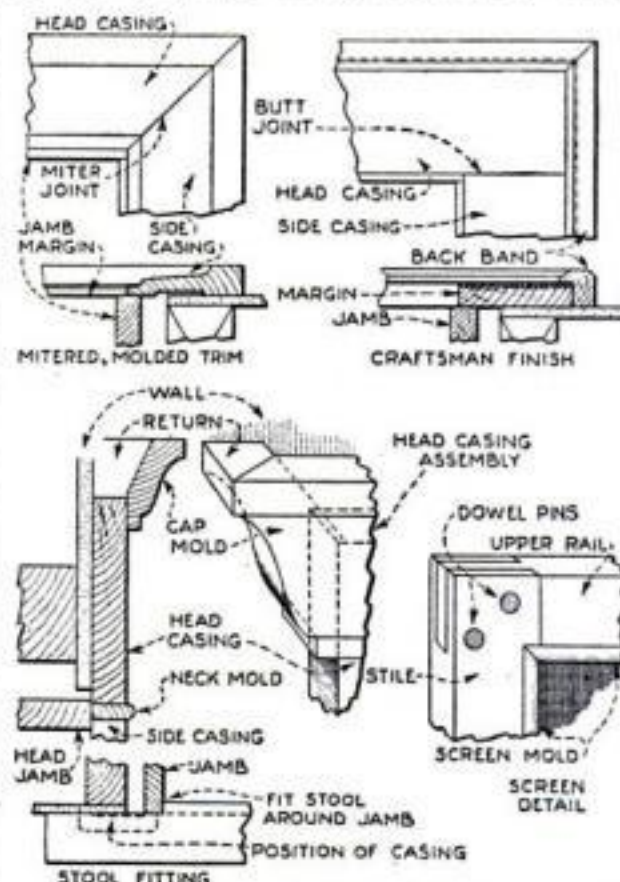
How to Apply Wooden Trim

(Continued from page 87)

joints, miter around any wall projections, and butt the end against the door casings. Scrape out all hammer marks from the trim and sandpaper thoroughly before painting.

For an attic room, $\frac{1}{2}$ by 3 in. batts are heavy enough for covering the wall-board joints and to form decorative panels. Run a band around the edge of ceiling, fitting joints neatly at the intersection of the slopes with the horizontal ceiling, and cut the joint strips between.

There are some difficulties in running picture mold around a ceiling of this kind. The lengths that run up the slope or rake must be narrower than the other sections; hence, to avoid trouble, it is best to use a simple mold, such as a cove,



Molded trim, a plain "craftsman" finish, cap mold and window stool, and corner joint for base

which can be narrowed and coped against the molding at the side. Narrowing the molding has the effect of increasing the thickness of the bottom edge, which must be beveled suitably from the back. Keep the mold down from the ceiling $\frac{3}{8}$ in. to allow the insertion of the picture hooks.

Cut the wall-joint strips between the picture mold and base, nailing with five-penny finishing nails driven as near the edges as possible, and slanting toward the studs, to prevent warping. The use of a straightedge and level will insure straightness and plumbness.

Build the screens of 1 by 3 in. stock for stiles and upper rails, and 1 by 4 in. for lower rails, joining the corners with the full mortise and tenon joint shown. Since rain would loosen glue, it is best to coat the parts with white lead, clamp firmly together, and insert $\frac{3}{8}$ -in. dowels to prevent the joint from coming apart. Use half-round screen mold to cover the edges of the screen wire.

The seventh article in the attic series will be published next month.

The Home Workshop

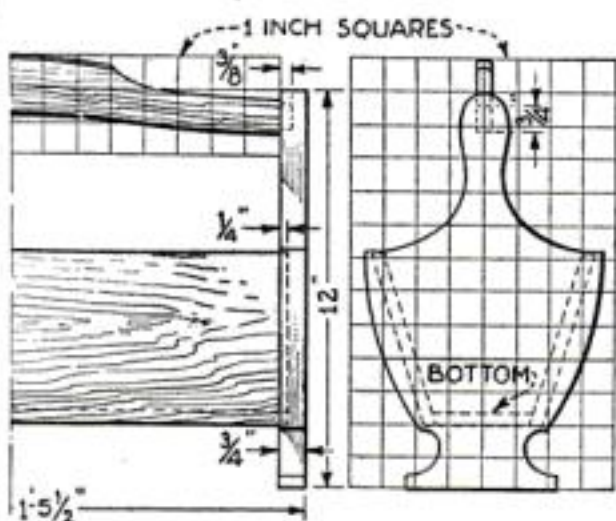
How to Construct a Portable Stand for Magazines



BUSY housewives regard with high disfavor the practice of leaving current magazines scattered around the living-room and the porch. They are certain, therefore, to welcome the ornamental little wooden "basket" illustrated, which, when placed beside a chair, forms a receptacle for the magazines that the reader may wish to have at hand. It not only keeps them together neatly, but also it can be carried from place to place.

Preferably the stand should be built of wood to match the furniture, but it may be of a cheaper wood if carefully stained and well varnished.

On a rectangle of light cardboard 8 by 12 in. lay out the long center line, as shown in the end view, and to the right of it rule off 1-in. squares. Point off on these lines for the intersections of the outline, and with an irregular curve draw the profile. Cut out with scissors, fold along the center line, and trace the other half,



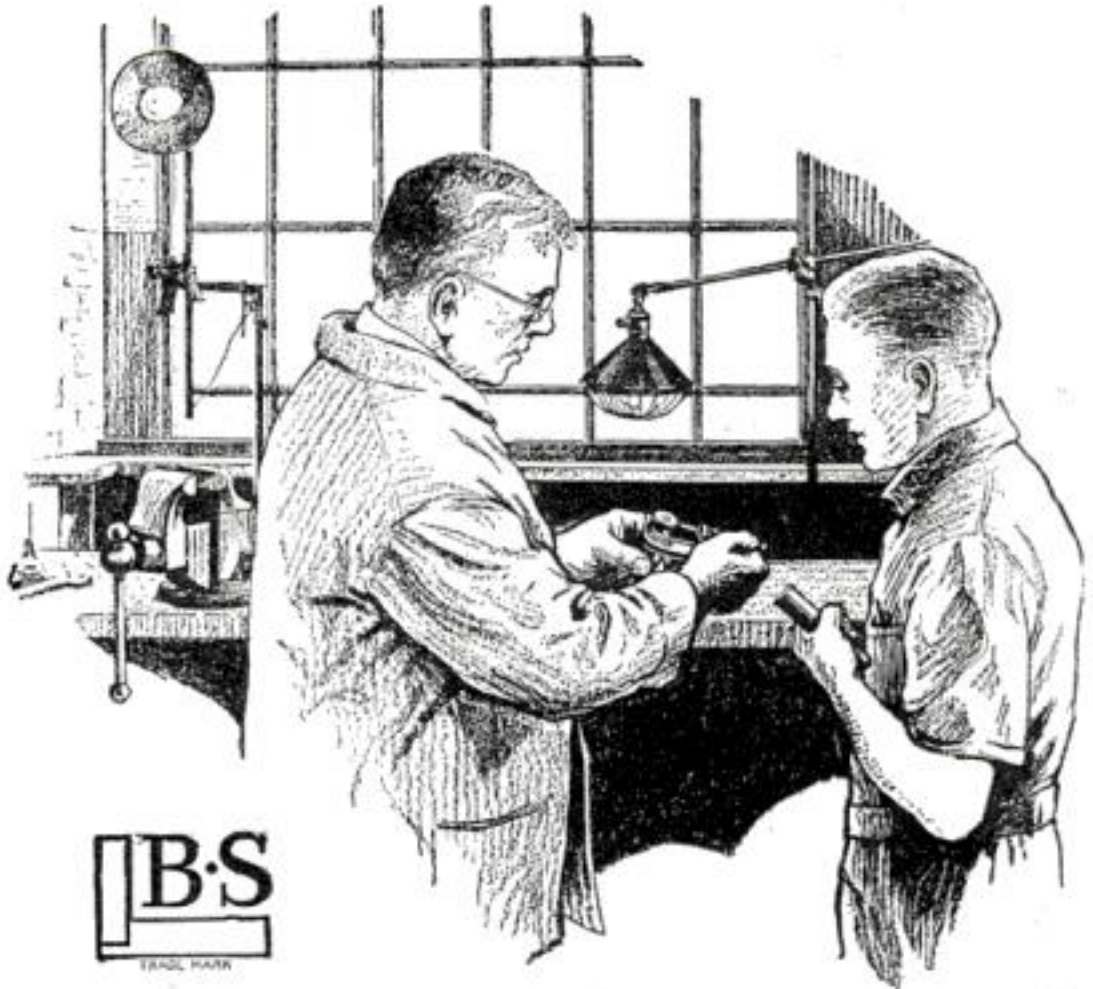
One-half the side elevation and the end view. The squares will aid in laying out the curves

cutting this out as well. Also lay out the $\frac{3}{8}$ -in. grooves into which side pieces fit.

Smooth up both sides of 1 by 8 in. stock for the ends, and trace the outlines. With a turning or a compass saw, cut out the ends, avoiding splintering as far as possible. Smooth the edges with spokeshave and wood rasp.

Using a $\frac{3}{8}$ -in. chisel, make cross cuts in the grooves every $\frac{1}{4}$ in., removing the

(Continued on page 90)



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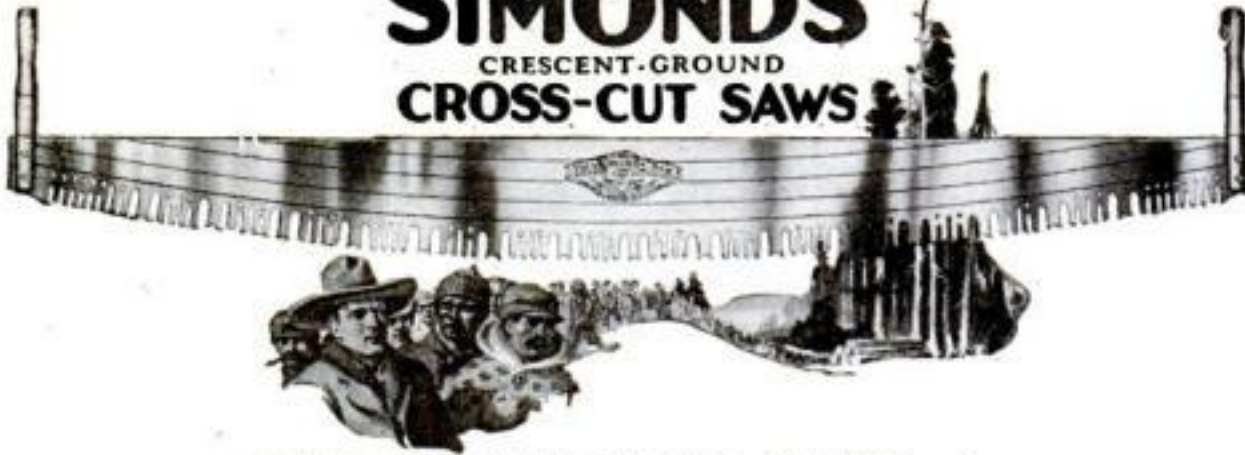
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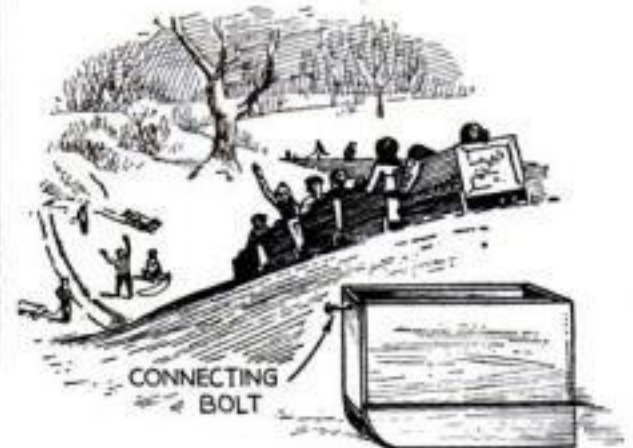
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The Home Workshop

Old Boxes Converted into a Coasting Passenger Train



ALL ready for a trip in the Sunshine Special! It is a passenger train of four or five dry-goods boxes, mounted on runners and fastened together with bolts leaving a play of 3 or 4 in. between coaches.

The coaches should be the right width to follow the slightly hollow track. A good size is 2 ft. wide, 2 or 2½ ft. deep, and 4 ft. long. Saw out runners of 1 by 8 in. stock equal in length to the box, and nail them to sides of box.—G. E. V. H.

Stand for Magazines

(Continued from page 89)

chips carefully to insure sharp corners. Finish ¼ in. deep.

The handle mortises are ¾ by ¾ by ¾ in. and are ¾ in. below the upper end. Scrape the ends smooth after all groove and edge trimming is done.

Cut the two sides of ¾ by 6 in. resawn stock 1 ft. 4½ in. long. Smooth according to the pattern. Try the ends in the grooves of the end pieces and where necessary plane off a trifle to allow ends to enter without crushing groove corners.

The handle is 1 by 2 in. stock 1 ft. 4¾ in. long. The pattern is copied by laying out the center line with a row of squares at one side, as in the case of the end pieces. Cut the ¾ by ¾ by ¾ in. tenons on each end before cutting out the design.

In assembling, coat the joining members with glue and clamp up solidly. To avoid scarring, put wooden blocks between the piece and the clamp jaws. Remove excess glue with a damp cloth, since stain will not take over glue.

When the basket is dry, make the bottom to fit snugly between the converging sides. A little glue and a few brads driven from the inside will hold it in place.

Sponge the piece with a damp cloth to raise the grain, and if there are any bruises, raise them by applying a hot flat-iron over a piece of moist blotting paper. When dry, sand smooth with 00 sandpaper, rounding the corners very slightly.

For stained work, stain with water, acid, or spirit stain. To avoid too deep a color, try the stain on a scrap before using. Then, if the wood is open grained, fill the pores with a good paste filler rubbed off across the grain.

Follow with two coats of shellac, well dried and sanded off, and finish with two coats of varnish. Rub the last with fine pumice stone and water, and lastly with rottenstone and water.—E. M. L.

The Home Workshop

How to Color New Cane Seat to Harmonize with Woodwork

NOW that the use of machine-woven cane has become so common, home workers frequently undertake the replacement of cane chair seats, backs, and decorative cane furniture panels. There is no great difficulty in removing the old splines, wedging the new cane in place while slightly damp, and gluing in new splines. The finished work, however, is apt to appear crude if the cane is not colored to harmonize with the woodwork.

Professional furniture finishers usually tone cane by spraying it with an alcohol wood stain mixed with wood lacquer. The amateur can obtain similar results by applying alcohol wood dye mixed with thin shellac and finishing with one thin coat of flat varnish. Another method of coloring is to give the cane a coat of japan, followed by a thin coat of tube oil-colors of the desired shade thinned with japan and a little varnish.

Ball-Bearing Bandsaw

(Continued from page 83)

arms. It is necessary to draw these bolts up fairly snug to prevent vibration. To provide for setting the wheels and spindles in the proper plane to have the bandsaw blade travel true, small setscrews, marked *D*, are provided.

A brake-drum 10 or 12 in. in diameter is an ideal drive pulley for the lower wheel. It is mounted directly on the hub of the wheel by means of three bolts through the hub. The motor may be mounted directly on the saw frame, set on the floor back of the saw, or placed on a bracket on the post to which the saw itself is attached.

A salvaged ball bearing is used as the friction wheel for the upper saw guide. The outer race of this is run against the back of the saw blade. Being hard, it suffers no wear, and since it turns readily it is ideal for this task. The upper guide is illustrated in detail. Sections are cut from 2 by 1 in. angle plates for the parts *E* and *F*. The parts *F* are riveted to the plate *G*, which is $\frac{1}{4}$ by 4 by 4 in. The parts that guide the blade are case-hardened.

Saw blades vary in width. To adjust the guide to suit different blades, which usually vary by eighths, washers are inserted back of the bearing so that the edge of the guide plates will be just even with the root of the saw teeth.

The saw guide is carried by a piece of square cold rolled steel. It is supported by a babbitted bearing mounted on the outer end of the cross arm. This bearing is not poured until all parts are lined up and a blade is in position on the wheel rims.

The lower saw guide is made from two pieces of hard wood mounted on a piece of 2-in. angle iron. The angle iron is 4 in. long and has a slot cut in the center of one leg. A cap screw *I* through this slot mounts the angle to the channel. Other cap screws and washers are used to hold the adjustable hardwood blocks to the face of the angle plate.



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Novel Ice Bell Box Enlivens
Skaters with Its "Music"



TINKLING sleigh-bell music accompanies the skater who has one of these amusing bell boxes to push before him.

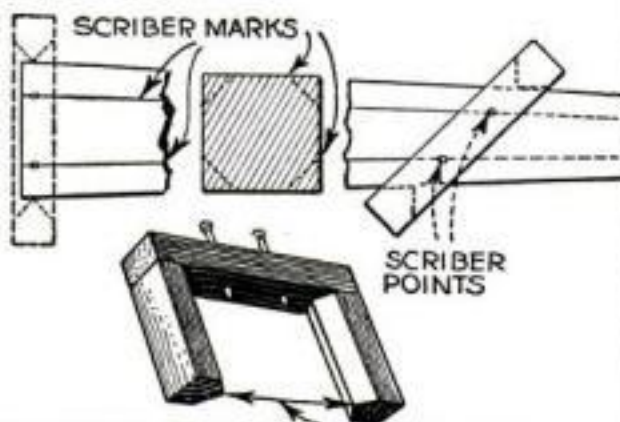
To make a musical cylinder of this kind, cut a strip of sheet iron or tin 18 in. wide and fasten it over two wooden hoops, which should be about 2 ft. in diameter. Use plenty of tacks in fastening each edge of the tin.

Fasten a strap of sleigh bells to each hoop and add any turkey, cow, or old dinner bells you may be able to obtain. Place a handful of gravel and some small stones inside the box, or anything that will make a continuous rattle. Cover the ends with screen, tacked firmly to the edges of the hoops.

A strip of wood 4 in. by 3 ft. with a 12-in. cross piece at the end is used for rolling the box ahead of you as you skate.
—G. EVERETT VAN HORN.

How to Lay Out Tapered Pedestals and Rods

WHEN the amateur woodworker has to construct a round tapered rod or pedestal of greater length than will fit between lathe centers, or if a lathe is not available, the work can be made easier by



EQUAL TO ONE SIDE OF OCTAGON AT
THE LARGE END OF THE TAPER

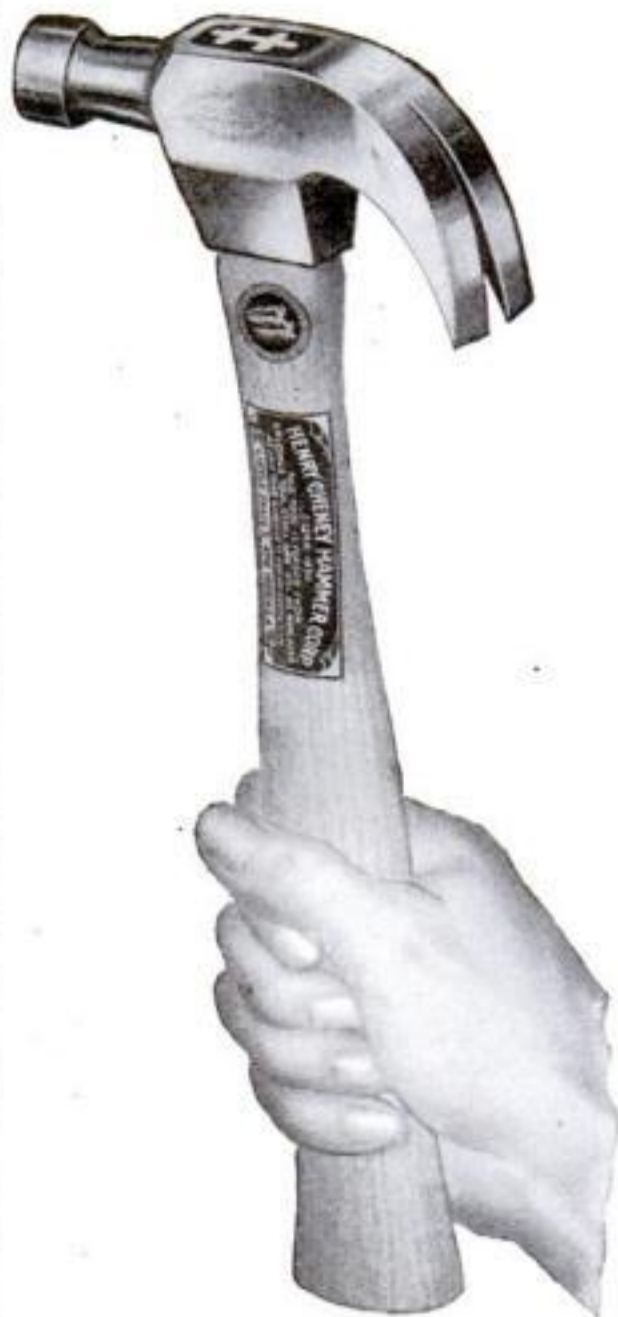
This gage is for marking square, tapered stock that is to be planed to an octagonal shape

using the gage illustrated for laying out the rough stock.

The wood, being in square section to start with, is planed to the correct taper. Then the gage is drawn from the large to the small end of the device and twisted so that the guides are kept constantly in contact with the edges of the wood. These marks serve for tapering the stock to an octagonal shape, and then it can be dressed round.—W. E. J.

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Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

IN FURNITURE factories and cabinet-making shops, blemishes and holes in finished woodwork are concealed with the aid of what are called shellac sticks. These sticks resemble ordinary stationer's sealing wax, but actually have a greater proportion of shellac. They are made in a great variety of colors and shades to match standard wood finishes and can be purchased in well stocked paint stores.

If, however, your own paint dealer does not carry an assortment of shellac sticks, you can make your own by melting 12 parts of orange shellac flakes, one part of powdered resin, and one part of beeswax. Do not allow the mixture to reach the boiling point or it will be too brittle. The wax can be colored either with alcohol wood dyes or with dry powdered colors such as burnt umber, burnt sienna, yellow ochre, Venetian red and lampblack. It pays to have a bit of each of these on hand as they can be combined to match almost any ordinary finish.



Mixing a stain

The wax is applied after the furniture has been stained and given a thin coat of shellac. All that is necessary is to melt it into any holes or cracks with a moderately hot knife or small soldering copper. When the wax hardens, cut off the surplus carefully with a sharp knife or chisel and rub lightly with fine, worn sandpaper.

FOR experimental purposes, the home workshop chemist can make a walnut-colored stain by adding a heaping teaspoon of pyrogalllic acid (the photographer's pyro) and a level teaspoon of cupric chloride to a glassful of alcohol. Stir well and brush the reddish stain on the wood. In an hour or two the brown color will develop.

A black stain may be prepared by adding to a glassful of denatured alcohol a heaping teaspoon of pyrogalllic acid and a teaspoon of a concentrated solution of ferric chloride in water.

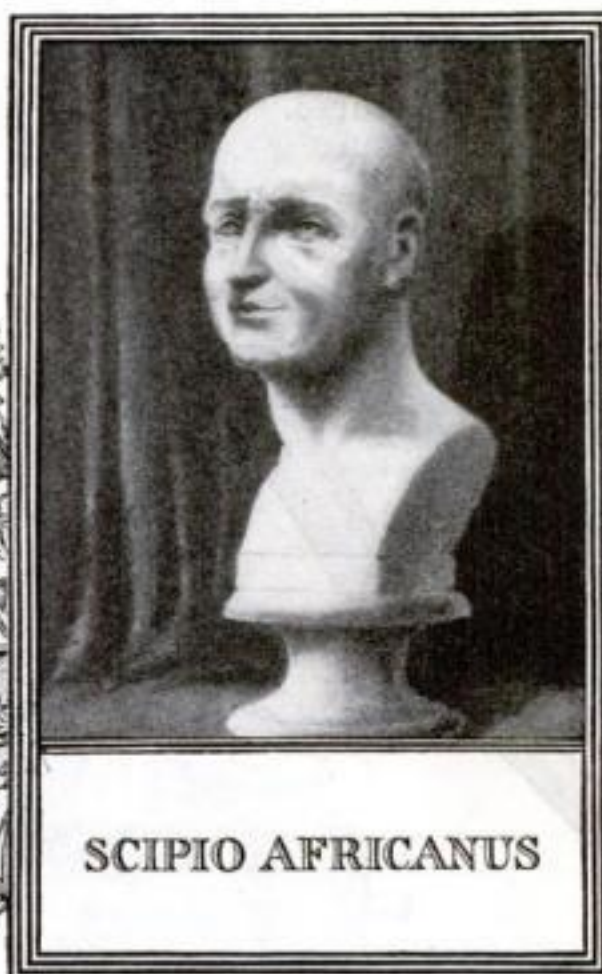
A blue-black stain is obtained by replacing the ferric chloride in the above formula with ferrous chloride.

A dark blue-green stain consists of a glass of alcohol to which is added a heaping teaspoon of pyrogalllic acid, a teaspoon of a concentrated water solution of potassium ferrocyanide and a teaspoon of a concentrated water solution of ferric chloride. Mix these thoroughly before attempting to use the stain.

Any of these stains will keep if they are in a tightly corked bottle.

TO MAKE metal-polishing bricks, mix 2 parts of pumice stone and 1 of plaster of Paris in water and pour into molds.

Why Scipio was called the most elegant gentleman of his time



SCIPIO AFRICANUS

ALTHOUGH Scipio Africanus never got into a controversy over the question of having a unified air service, few of our present-day celebrities have greater renown than he had when he was "going good."

Scipio hung up a long string of important military victories, brought the championship of the Mediterranean League to Rome, and spoke Latin fluently.

But that was not all. "The younger Africanus was the first who adopted the custom of shaving every day."

—Pliny's Natural History, Book 7, Chapter 59.

It was because he had progressive ideas and saw the advantage of the daily shave that Scipio won the reputation of being the most elegant gentleman of his time.

The Analogy Between Scipio and Colgate's

By causing whiskers to come off, Scipio was distinguished among his compatriots. Colgate's Rapid-Shave Cream is distinguished for causing whiskers to come off more easily.

It makes the daily shave a matter of but a few minutes, with no nerve-racking accompaniments.

Colgate's Softens the Beard at the Base

The moist, fine-texture lather goes directly to the base of the hair, where it is most needed. It softens the toughest beard almost instantly, and so effectively that the razor has no more pull than a Bolshevik could develop at Washington.

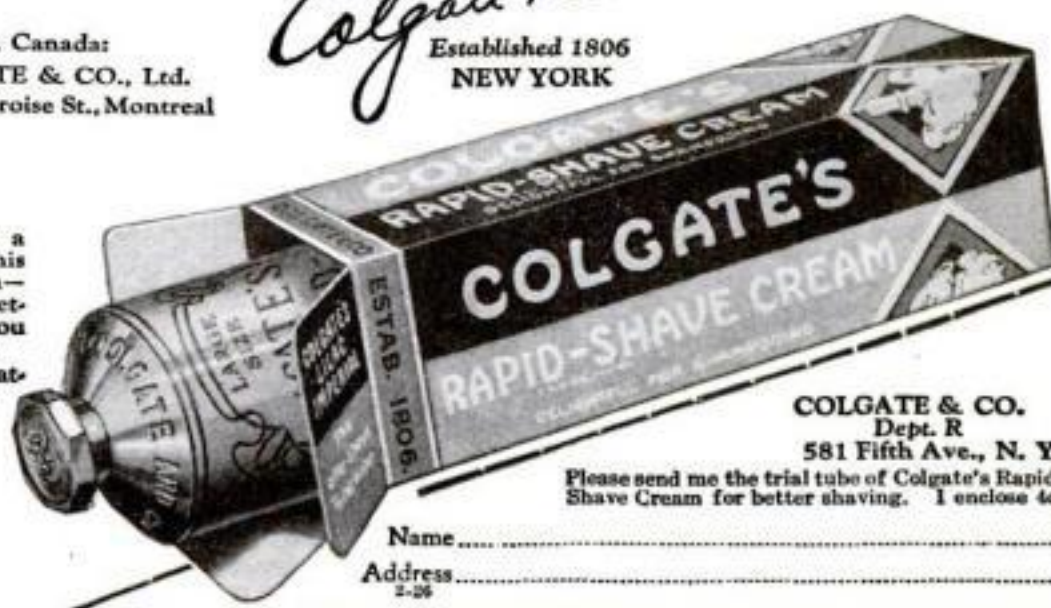
Millions of men find Colgate's greatly superior to anything else they have ever used for taking discomfort out of shaving. It combines the best qualities of other shaving creams, and has important merits that are not to be found in any of the rest.

Colgate's needs no mussy rubbing in with the fingers. It leaves the face cool, velvety and refreshed.

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Let us send you a trial tube of this marvelous Cream—enough for 12 better shaves than you have ever had. Please use the attached coupon.



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Please send me the trial tube of Colgate's Rapid-Shave Cream for better shaving. I enclose 4c.

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2-26

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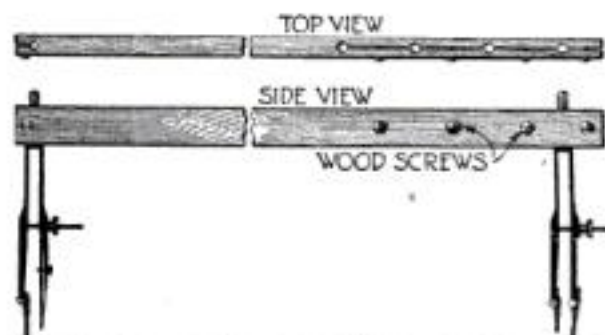
NORTHWESTERN ELECTRIC CO.
410-420 S. Hoyne Ave., Dept. 2, Chicago, Illinois

The Home Workshop

Beam Compass Improvised from Small Bow Instruments

HAVING immediate need for a beam compass for drawing some very large arcs, I contrived to make a satisfactory substitute by using the bow instruments from my drafting set and a wooden bar, as shown below.

The beam is a piece $\frac{1}{4}$ by $\frac{1}{2}$ in. in cross section. At one end, I drilled a series of



Bow compasses from an ordinary drafting set are inserted in ends of a light wooden rod

holes at 1-in. intervals, as one inch was the distance my bow pencil would open. At the other end, I drilled a single hole for the bow pen. After sawing slots through the holes, as indicated, I inserted small round-headed wooden screws for clamping the instruments in place.—W. J. E.

Simple Radio Cabinet

(Continued from page 85)

is open grained. Next should come a coat of thin shellac. Sandpaper slightly and varnish. Let the first coat dry two days; then sandpaper and varnish again. Rub down with fine powdered pumice stone and water, if you want a dull finish.

The radio panel is supposed to be set at an angle with the base, either by using angle irons or by planing a cleat to the proper angle and screwing the panel to it. The panel, however, can be set vertically, in which case it should be 2 in. from the front of the apparatus board. The whole set slides on cleats put into the cabinet for the purpose. Wires from the batteries are led in through holes.

A hinged lid can be placed in front of the radio panel. In that case set the panel back 1 in. more so the lid will clear the dials when closed. Hinge the lid to the edge of the apparatus board.

For ornamentation you might try rounding the edges of top and ends and carving a line $\frac{1}{2}$ in. or more from the edge around the inside of each panel and end. Use a small gouge. Then gild the groove with a small brush.

If the back is omitted, the end compartments may be entered from the back, making the doors unnecessary. In this case nail the door panels in instead of hinging them. It is more convenient to have the doors.

In case the radio fan already has a set, but wants a place to put his batteries and the like, he can cut down the height of the cabinet by shortening the end panels and all uprights to 16 in.

Finally, the end panels can be nailed in and the center panel hinged, or the end panels can be nailed in and the center panel omitted entirely.

The Home Workshop

Blueprint Shows You How to Build a Pirate Ship Model

WHEN you read Captain McCann's article on how to build a miniature Barbary felucca, which begins on page 73 of this issue, the chances are that you will want to make one of these gorgeously colored and extraordinarily decorative little pirate ship models. It is really a very simple task. The materials cannot cost you more than three dollars and, indeed, you may be able to find everything necessary among the odds and ends that accumulate around every workshop and home. The finished model will be worth about \$100 at current rates, if it is a reasonably careful copy of the original.

Home Workshop Blueprint No. 44 shows the full size hull of Captain McCann's model. On the sheet, which is 15 by 22 in., is a pattern of the centerpiece, with the ornamental stern carving, a full size view of the side pieces, and drawings of the other parts of the hull.

In ordering the blueprint, please use the coupon below.

Complete List of Blueprints

ANY one of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The Editor will be glad to answer any specific questions relative to tools, material, or equipment. Blueprint Service Dept.

Popular Science Monthly

250 Fourth Avenue, New York

GENTLEMEN:

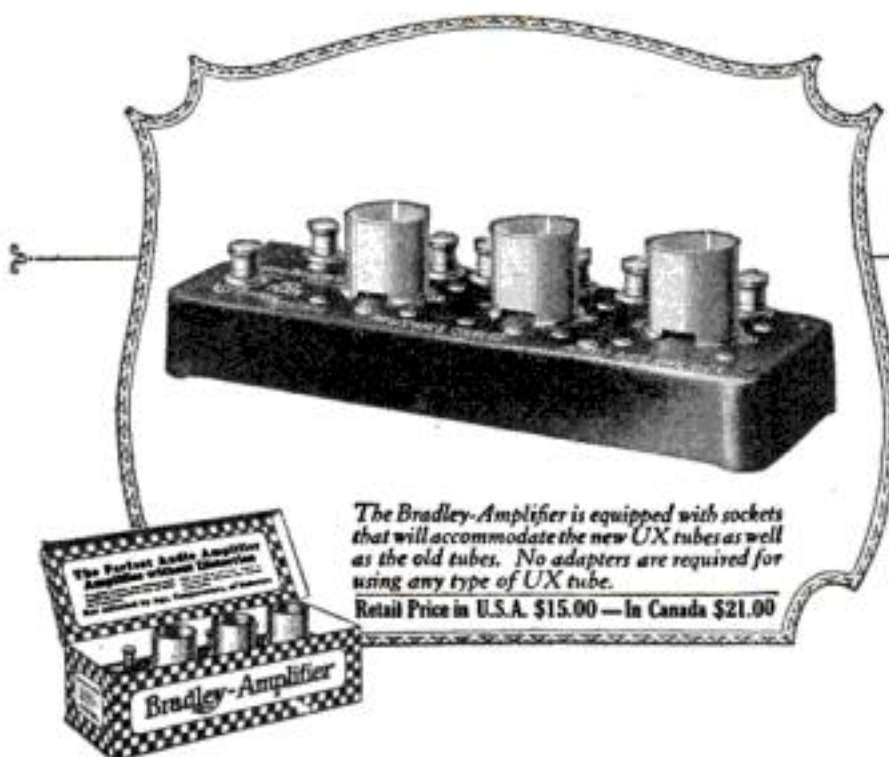
Send me the blueprint, or blueprints, I have underlined below for which I inclose cents:

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34.	Garden Trellises	May, '24	25c
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The Bradley-Amplifier is equipped with sockets that will accommodate the new UX tubes as well as the old tubes. No adapters are required for using any type of UX tube.
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The Heart of the Bradley-Amplifier



TUCKED away within the polished bakelite base of the Bradley-Amplifier are six inconspicuous, solid molded resistance units known as Bradleyunits. They are permanently soldered into place and can never work loose or cause trouble.

The Bradleyunit is the heart of the Bradley-Amplifier because it alone can amplify the incoming tone frequencies without distortion. It replaces the ordinary bulky audio-frequency transformer and eliminates the most frequent cause of distortion in a radio receiver. The Bradleyunit cannot deteriorate or change with age.

Surprise Your Friends With The Improved Tone Quality of Your Radio Set

IT IS NOT ENOUGH that a good radio receiver is selective or is able to bring in distant stations. Quality of reproduction is now considered as important as selectivity and sensitivity.

Fortunately, the tone quality of your radio set can be quickly improved and perfected without disturbing the existing wiring of the set. All that is necessary is to replace your present audio-transformer amplifier with a Bradley-Amplifier. This compact unit employs no transformers and amplifies all tone frequencies with faithfulness and clarity, and without distortion.

It is a mark of distinction to have a radio receiver of fine tone quality and you will surprise your friends with the remarkable improvement in your set that follows the use of a Bradley-Amplifier. It is as easy to install as a B-Battery and usually can be installed within the receiver cabinet.

Be sure to try one, tonight.

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We will gladly send you our booklet, "The New St. Louis," if you will write for it.

Address
Dept. 16



The Home Workshop

A Pirate Ship Model

(Continued from page 73)



west. The dusky crew is swabbing out guns that still are smoking hot, and the occasional crack of a whip tells of the desperate efforts to which the galley slaves are being driven. Only its great speed has saved this Algerine corsair from destruction by the warships of Commodore Preble—the squadron that included the *Constitution* and won glory for the young American Navy by driving the Barbary pirates from the seas.

To make a model of this pirate ship, you will need a saw, small hammer, chisel, a fine awl (this can be made from a three-cornered shoemaker's awl, filed very thin at the point), something to bore or drill $\frac{1}{8}$ - and $\frac{1}{4}$ -in. holes, a plane, a pen-knife, and a fretsaw. A spokeshave is useful. Other tools may be helpful, if you have them, but not absolutely necessary.

THE model is 20 in. in length and 17 in. high over all. If you wish to make your model larger or smaller, you will have to increase or decrease all dimensions proportionately.

A full-sized working drawing of every part should be made first. You can save yourself this work, however, by sending 25 cents for Home Workshop Blueprint No. 44, which gives full size details of the hull. Address, Blueprint Service Department, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York.

Where any particular material is mentioned, it is what the writer used and in his opinion is the best or the most easily handled for the purpose, but any other may be substituted. For example, where three-ply is given, single-ply wood or even thick cardboard will do. For press-board (to be obtained from a printer, bindery, or large stationery dealer) a good quality of cardboard will answer.

Draw the outline of the center piece A on a piece of $\frac{1}{4}$ -in. three-ply wood 4 by 20 in. Also draw the construction lines II to VIII on both sides of the piece. These lines are $2\frac{1}{2}$ in. apart. Note where the center piece rises in the stern to the height of the upper deck. Saw this out,

(Continued on page 97)

War brought him his pipe-tobacco thrill

While Mr. Ellender of London isn't in favor of war for the purpose of finding a better tobacco, nevertheless one of the unforgettable memories of the last one seems to be his discovery of Edgeworth.

And the fact that Edgeworth tobacco is available throughout most of Europe has made it possible since the war for this Londoner to enjoy his pipe of peace.

Read his "hands-across-the-sea" letter:

Larus & Bro. Co.,
Richmond, Va., U.S.A.
Gentlemen:

I've just read in a magazine the remarkable letter of the traveling man in Seattle, who smoked five-eighths of a ton of Edgeworth tobacco.

Until early 1918 I didn't know that such pipe tobacco as Edgeworth was waiting to be enjoyed.

It was a U. S. Army man who gave me my first can, and with the idea that it couldn't be as good as the usual tobacco I had smoked since 1911, I decided to try a pipe.

I've smoked all kinds of tobacco during the war with the British Army. I even smoked tea leaves when I couldn't get tobacco—in fact, I smoked anything that would fill a pipe, but Edgeworth won all battles.

Right from the first can I've kept to Edgeworth at Base 3, Headquarters Section of the United States Army.

Your traveling man didn't have any trouble to obtain his supplies like I have had. Running around England for a dealer who stocked Edgeworth is not an easy run, but I have been amply rewarded when a dealer did say, "Yes, I have a stock."

Edgeworth doesn't bite the tongue—doesn't give that thirsty-after-smoking feeling, satisfies always, and always comes in tip-top condition. I have to hide my can, for others like it like I do, but I cannot afford to supply them all. Let them search for it like I have done. Then they will enjoy it better.

Yours very sincerely,
Theodore Ellender

Let us send you free samples of Edgeworth so that you may put it to the pipe test. If you like the samples, you'll like Edgeworth wherever and whenever you buy it, for it never changes in quality. Write your name and address to Larus & Brother Company, 10 N South 21st Street, Richmond, Va.

We'll be grateful for the name and address of your tobacco dealer, too, if you care to add them.

Edgeworth is sold in various sizes to suit the needs and means of all purchasers.

Both Edgeworth Plug Slice and Edgeworth Ready-Rubbed are packed in small, pocket-size packages, in handsome humidors holding a pound, and also in several handy in-between sizes.

To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Edgeworth Ready-Rubbed for the same price you would pay the jobber.



The Home Workshop

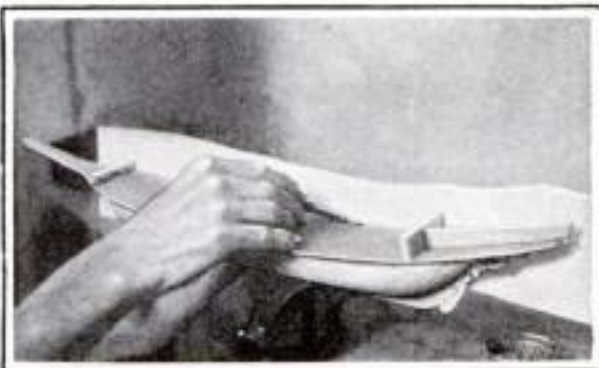
A Pirate Ship Model

(Continued from page 96)

lightly carve the scrollwork in the stern and the rudder with the point of a sharp penknife, and round off the lower edges with sandpaper.

Take two pieces of white pine (B) or other soft wood $1\frac{1}{2}$ in. thick (four pieces of $\frac{3}{4}$ -in. shelving glued together in pairs will do). Each piece should be 2 in. deep and $14\frac{1}{2}$ in. long. On the top of one mark the sheer (deck line) and cut down to this. Lay it on your full size drawing or the blueprint and mark all round it the lines III to VII. On the deck (upper) side mark the deck outline and cut away the waste. On the midship side mark the vertical profiles fore and aft and cut away the two ends to this.

Make full size section lines by enlarging the diagram on page 73, or trace from the blueprint the cross section lines of the hull at the points III, IV, V, VI, and VII. Transfer these lines to thin cardboard and cut them out to serve as five separate templates. Then shave away one of the hull pieces (B) until it agrees with



The rails are laid out by holding pressboard against the ship and tracing the deck line

the templates. Do not cut the points at the bow and stern fine until the very last—they are easily broken off.

Now shape the second piece the same way, only to go on the opposite side. Hold them together occasionally, with the lines coinciding, to see that they match. This is much more important than that their contour be exactly the same as the plan. A little variation in the profile of the hull does not matter in the least; the general effect is all you are aiming at.

Glue and lightly nail the pieces B to the center piece.

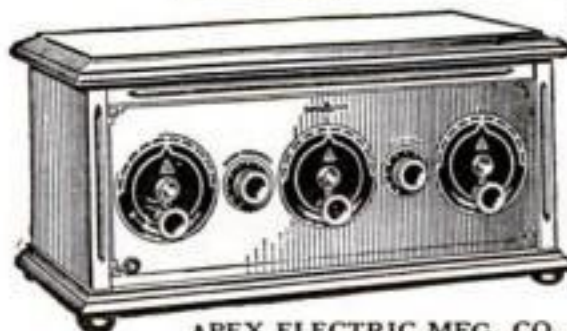
Take a piece of pressboard $\frac{1}{8}$ in. thick by $3\frac{3}{4}$ in. wide and 20 in. long. Mark its shape (D) from the deck plan, which in the blueprint shows everything in the actual size. Lay it on the deck, pressing it down into the sheer, to see that it fits at the ends. Then cut it out with your fretsaw, smoothing the edge with sandpaper to an even right angle. It will need a slot at the stern to take the extension of the center piece. Glue it in place and lightly nail it with $\frac{3}{8}$ -in. brads. It will overhang the hull pieces by about $\frac{3}{8}$ in. amidships.

At about $\frac{1}{4}$ in. below this bore ten $\frac{1}{8}$ -in. holes in the hull for the oars. These holes should point in toward the bow at an angle of about 45 deg. and up at a slighter angle.

In line with the foremast, bore three

(Continued on page 98)

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The purchase of a Radio Receiving Set is no longer a gamble. You do not have to take anything for granted. Your own eyes and ears will act as dependable witnesses when you investigate the new APEX SUPER FIVE.

You will see the most artistically designed and handsomely finished Radio set you ever set eyes on. You will see the very features you have always wanted, positive control—finest of selectivity.

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You will realize why radio enthusiasts in increasing thousands are giving decided preference to the APEX SUPER FIVE—the most attractive and accurate instrument of the radio era.

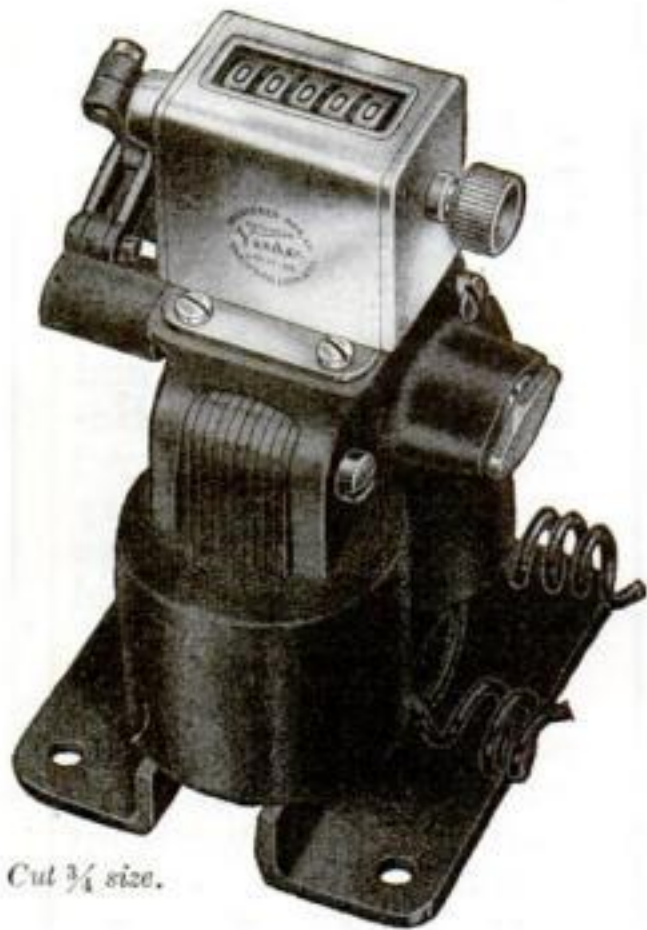
A few minutes' investigation may save you months of regret. Let us demonstrate—here or in your home. \$80—without accessories.

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Counts machine output or operations, and puts the figures right before you—wherever you put the counter. No need to go near a machine, to know its production. The record is flashed through "by wire."



Cut $\frac{3}{4}$ size.

Either oscillating movements or revolutions make the contact which operates this counter. The lightest touch (either "wiping" contact or make-and-break), makes the record.

Objects too small or light to actuate a mechanical counter, register on the new Magnetic. Even sheets of paper on a paper-making machine, or light little packages on a conveyor, will work the contacts which control the magnetic drive. Your lighting circuit (direct current) supplies the power. Or storage battery.

Above all is the new convenience of getting your count from remote points in the shop to the handiest points for supervising.

Write for special Bulletin on Magnetic Counters—or the full-line Counter Catalogue if you haven't it.

The Veeder Mfg. Co.
44 Sargeant St., Hartford, Conn.

The Home Workshop

A Pirate Ship Model

(Continued from page 97)

small holes in the sides of the hull for the rigging, and in line with the mainmast four holes for the mainmast rigging. They should be close under the deck.

If you would like a molding to indicate the edge of the lower deck, where the slaves sit rowing, use a piece of smooth cord about $\frac{1}{16}$ in. in diameter (heavy fishing line does well). With an upholstery nail fasten one end near the bow. Run some glue right along the line, and when well stretched, nail the other end similarly at the stern. If necessary, pin the cord temporarily to the hull to keep the curved line. This line can be seen just below the oars in the photograph of the finished model on page 73.

If you are going to have the underwater body of a different color from the topsides, mark the waterline. Fasten a pencil on a block of wood so that the point projects at a height of 1 in. from the table



Drawing the water line with the aid of a pencil held with nails to a $\frac{1}{4}$ -in.-thick block

on which the model rests. Then, holding the model upright, scribe right round as illustrated above.

The construction of the main part of the hull now being complete, it would be well to make the base, or stand. This can be of any wood—walnut, mahogany, or oak perhaps being the best. Two pieces, from $\frac{1}{4}$ to $\frac{1}{2}$ in. thick and $1\frac{1}{2}$ in. by $3\frac{1}{2}$ in., will be needed. Fretsaw these along the top to the shape shown and to any decorative outline you please below. You can make two carved dolphins of them if you like. The slot must be an easy fit for the keel. Below, bore holes to take a piece of $\frac{1}{4}$ -in. dowel stick about 5 in. long, which will hold the pieces upright.

From your three-ply or other wood make the fore and after bulkheads *E* and *G* and nail and glue them on the deck in the places shown. They must come exactly flush with the edges of the deck. On the after bulkhead paint doors and windows, to be seen through the overlay *F*, which is applied later.

From some $\frac{1}{2}$ -in.-thick pressboard make the bulwarks and hand rails (*C*) in one piece for each side. Before you cut the strip, stretch it upright along the deck, fasten it with thumbtacks to the bulkheads, and draw the line of the deck on it. The other lines may be drawn by measurement in case your sheer and length do not correspond exactly with the drawing or blueprint.

Every few inches a flap about $\frac{3}{8}$ in. square or a trifle less should be left hanging from it; these will be glued under the

(Continued on page 99)



Balkite Radio Power Units

the ideal radio power supply

The Balkite Battery Charger and Balkite Trickle Charger for charging "A" batteries—entirely noiseless. Balkite "B" replaces "B" batteries—for sets of 6 tubes or less. Balkite "B" II—for sets of 6 tubes or more.

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ALL BALKITE RADIO POWER UNITS ARE TESTED AND LISTED AS STANDARD BY THE UNDERWRITERS' LABORATORIES

The Home Workshop

A Pirate Ship Model

(Continued from page 98)

deck. Note that the line you mark will be the top of the deck and the rail has to go to the lower edge, so that the thickness of the deck must be left below the line.

Before putting it in place, mark on the rail the gun ports, which should be a full $\frac{1}{4}$ or $\frac{3}{16}$ in. square. Cut three sides of each so that the piece will lift up like a flap. Cut away the perforations of the hand rails and the four windows in the stern; behind these cement or glue pieces of gelatine (a waste photo film will serve). Leave an extension right astern to glue round as far as the midship line.

Glue and nail these pieces to the forward bulkhead; glue their edges, stretch them along and fasten them to the after bulkhead. Glue the flaps and hold or clamp them under the deck until dry.

Cut pieces of any scrap wood to fit right in the stern touching it, the center-board, and the sides. This to support the upper deck at the stern and to take the stern lanterns, which will be made later.

Now cut the sternboard *J* to the pattern shown or any other you please. This may be carved from a piece of cigar box and gilded and painted or varnished. Glue and nail it in position.

Make an overlay of the pressboard to cover the after bulkhead, with doors and windows cut out and a handrail above.

FOR the after upper or poop deck, cut a piece of pressboard (*H*) to extend from the after bulkhead to the stern and from side to side inside the rails. Glue and lightly nail this to the wood beneath.

Cut a piece (*I*) similarly to fit at the fore end, but extend this to the height the deck is to be and then another $\frac{1}{4}$ in. or so. Bend it under at the dotted lines, put some glue on the extensions, turn it over and fasten them to the deck; then bend it round and glue and nail to the forward bulkhead, so that it stands level.

Bore $\frac{1}{4}$ -in. holes for the masts where shown. The foremast is to slant forward at about 20 deg. from the vertical, and the mainmast at 10 deg.

That completes the construction of the hull. It should now receive a priming coat of paint, unless it is to be left in the natural wood, in which case it will need staining and two or three coats of varnish. Rub down between coats and dull the last with pumice stone and water.

I left the upper half of the hull natural wood, and painted the under water body a Mediterranean (ultramarine) blue. The upper works are crimson and gold.

The painted parts first had a coat of white, which was rubbed down smooth with sandpaper and steel wool; next a coat of blue and red, a shade lighter than the desired colors. This also was rubbed down. Then a glaze coat of artist's oil colors, thinned with varnish, was applied, giving a very brilliant finish.

The decks can be covered with Japanese veneer paper, or thin wooden veneer, or may be painted like planking. Japanese paper is easiest to apply, if you can get it.

The sails and accessories will be described next month.



The Future of the Telephone

IT WAS fifty years ago that Alexander Graham Bell invented the telephone, and yet this anniversary is but a milestone in the progress of telephone development. As the giant oak with its complicated structure grows from the acorn, so a nation-wide system has grown out of Bell's single telephone instrument.

The interconnection of millions of telephones throughout the land, regardless of distance, has not come about easily. It has resulted from a series of scientific discoveries and technical achievements embodied in a telephone plant of

vast extent and intricacy. Great economies have already been gained by such technical improvements and more are sure to follow for the benefit of telephone users everywhere.

There are still to come many other discoveries and achievements, not only in transmission of speech, but also in the material and construction details of every part of the network of plant.

The future of the telephone holds forth the promise of a service growing always greater and better, and of a progress—the end of which no one can foresee.

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LINCOLN RADIO CORPORATION, 224 N. Wells St., Chicago

The Home Workshop

Enameling Furniture

(Continued from page 74)

color than any you can buy is required. In that case obtain a tube of artist's oil paint of the desired color. Mix a small quantity with turpentine and stir well into white, cream, or other colored enamel.

It is desirable, although not absolutely essential, to apply to the bare wood a thin coat of white shellac—that is one part ordinary white shellac diluted with one part denatured alcohol. Sandpaper this lightly and give a coat of the enamel undercoater. This is a flat and rather thick paint that gives an opaque body for the more expensive enamel. Enamel itself is somewhat transparent and without the aid of the undercoater it would be difficult to build up a good finish, especially with light colored enamels such as white, ivory, and pale yellow, blue or green. With dark colored enamels the undercoater may be omitted, although it is not to be recommended.

IN MOST cases it is necessary to sandpaper the first coat of undercoater after 48 hours and apply a second. Even if the first coat was flat white, this coat should be tinted approximately the same color as the finishing coat of enamel. If your paint dealer does not happen to have undercoater of the right color, you probably can obtain a colored flat wall paint that will serve the purpose. If not, mix half enamel and half white undercoater together.

Allow this coat to dry for 48 hours or until stone hard, then rub the surface lightly with No. 00 sandpaper or fine steel wool, and you are ready for the enameling.

The correct way to apply enamel is to brush it on freely with the grain of the wood. Then, without adding more enamel, "lay off" the surface with brush strokes across the grain. Finally brush the enamel lightly once more with the grain, leaving a film of uniform thickness. This will prevent what are known as "sags" and "holidays."

Bear in mind that you cannot do good work if your brush is not perfectly clean. Keep it from hardening between coats by suspending it in a tin of turpentine; the bristles should not touch the bottom of the can, and the turpentine must cover the bristles entirely.

In two days the first coat of enamel should be quite hard, so that you can apply a second coat. For some purposes a second coat is not necessary; it depends upon the quality of the undercoats, the smoothness of the original surface, and how fine a finish you wish. Usually a second coat of enamel more than repays for the trouble of putting it on. It often makes all the difference between an amateurish or a professional looking job.

THE coat can be allowed to stand in its original gloss in a sort of bright porcelain effect, or it may be rubbed to a more artistic dull finish with fine powdered pumice stone and water applied with a piece of painter's rubbing felt or

(Continued on page 101)



Learn to Play a Harmonica via Radio

To stimulate interest in good music by teaching people to play instead of merely listen, a series of harmonica programs and lessons, known as the "Hohner Harmony Hour," are being broadcast through Stations WEA, New York; WJAR, Providence; WEEI, Boston; WOO, Philadelphia; WCAP, Washington; WGR, Buffalo; and WWJ, Detroit.

In addition to the musical numbers, ranging from the "bluest" of jazz selections to classical and operatic compositions, a series of harmonica lessons are broadcast by a well-known instructor.

If you want to enjoy one of the most popular features "on the air" and learn to play a harmonica for pleasure or profit, procure a copy of the Free Instruction Book and "tune in" for the "Hohner Harmony Hour." If your dealer cannot supply you Address M. Hohner, Inc., Dept. 182, 114 East 16th St., New York.



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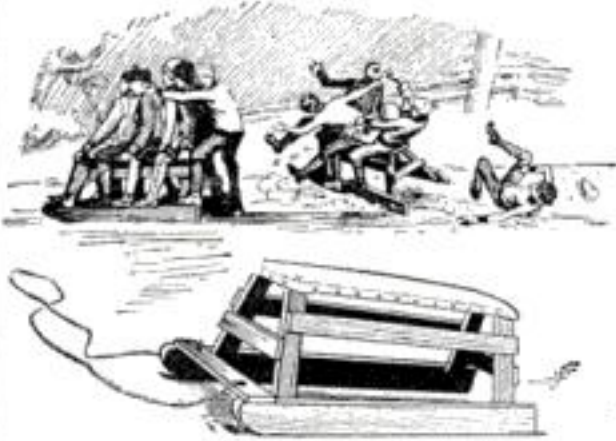


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The Home Workshop

The "Straddle Bug" Provides New Coasting Thrills



WOODEN runners will transform an old sawhorse into a novel "straddle bug" for coasting. Saw the runners from 1 by 8 in. boards, 2 ft. longer than the sawhorse. Bevel the under edges so that each runner will lie flat and bolt the pieces to the outside of the sawhorse legs. Brace well as shown. Cushion the top by stretching a strip of canvas over it and stuffing old rags or excelsior underneath.—G. V. H.

Enameling Furniture

(Continued from page 100)

with an old piece of clean felt, such as from a soft hat. Use plenty of water and rub lightly. For an especially fine surface the rubbing should be continued with rotten stone and rubbing oil or water. Use water in the case of white enamel.

The labor of rubbing can be avoided by the use of a specially prepared egg-shell finish, which can be purchased instead of high gloss enamel, but the rubbed finish is to be preferred. In fact, eggshell enamels often are rubbed to bring out their full beauty.

Old work to be enameled may be handled in two ways. The best is to remove the old finish entirely with varnish remover applied as directed by the manufacturer. A much quicker and often quite satisfactory method is merely to wash the surface well with linseed oil soap or pure white soap and warm water. Rinse thoroughly, dry and sandpaper the surface with No. 00 sandpaper or steel wool to cut the gloss of the old finish.

The old work then can be finished exactly as if it were new, although some finishers make it a practice to vary the process as follows: The first coat is a mixture of equal parts of enamel and flat undercoater; the second is flat undercoater alone; the third is the same mixture as used for the first coat, and the fourth is a finishing coat of enamel.

Decorations can be added in various ways. Small ornaments, stripes, and bandings may be painted on freehand either with enamel colors or with artist's oil colors thinned with varnish. Commercial or homemade stencils may be used, especially if there are a number of pieces in one set. Decalcomanias, as ornamental paper transfers are called, may be had in some art shops and give much the same effect as hand painted ornamentation. Even pictures cut from magazines may be applied to the furniture and varnished heavily.

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Write for the Boice new 64-page booklet containing helpful information and describing Boice Bench Circular Saws, Band Saws, Jointers, Jig Saws, Lathes, Drills and Mortiser. Also the Boice E-Z Pay Plan and positive money-back guarantee.



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The Home Workshop

Stand for Baby's Bath

(Continued from page 102)

Lay out and cut the shelf to the dimensions given. Take care to be very accurate in cutting out the notches for the legs. The shelf is held in place with nails driven through the end panels and also by long finishing nails driven through from both outer faces of each of the legs.

The partition next is cut to size and held in place temporarily with nails driven only part way so that they may be withdrawn easily. It may be necessary to remove this partition later in case the tub rests on it before making a close fit in the opening cut in the top.

To determine the size and shape of the opening for the tub, proceed as follows: First measure your tub in both directions at points about $3\frac{1}{4}$ inches down from the rim. This will give you the maximum

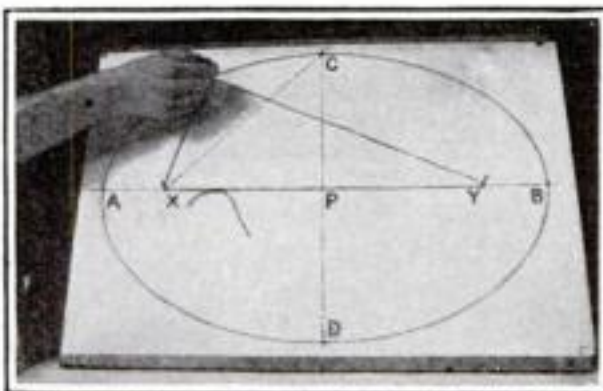


Fig. 2. How the oval is drawn with the aid of a loop of string passed loosely around two nails

length and width of the elliptical opening you must make in the top.

Draw two center lines on the board prepared for the top and lay off what are called the major and minor axes (AB and CD). Measure one-half of the major axis, or AB, and transfer this measurement from C to whatever point it will reach on the major axis, or Y. Do the same to locate point X.

Drive brads at points C, X, and Y, and tie an inflexible cord around the three. Then remove the brad at point C and with a pencil held in a vertical position and inclosed by the twine, draw the ellipse in the manner illustrated in Fig. 2.

This method will give a true ellipse. It is applied frequently in laying out elliptical flower beds, grass plots, and fish ponds, to determine the ends of lattice-work forming an elliptical arch, as for trellis or arbor, and in furniture making.

Bore a hole on the inside of the line made on your top board, insert a compass or keyhole saw in this hole, and saw

(Continued on page 104)

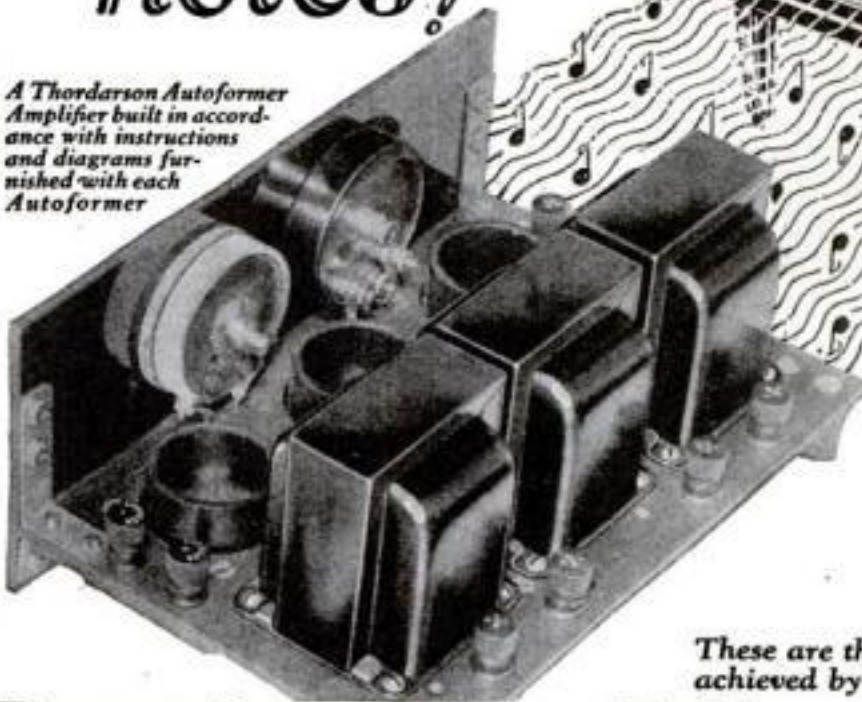
Bill of Materials for Bathtub Cabinet

No.	Pcs.	T.	W.	L.	Part
4		$1\frac{1}{2}$	$1\frac{1}{2}$	$18\frac{1}{4}$	Legs
2		$9\frac{3}{4}$	$10\frac{1}{4}$		End panels
2		$3\frac{1}{2}$	$9\frac{3}{4}$		Front panels
2		$3\frac{1}{2}$	$9\frac{3}{4}$		Back end panels
1		$9\frac{3}{4}$	$17\frac{1}{2}$		Back panel
1		16	$21\frac{3}{4}$		Shelf
1		6	$21\frac{3}{4}$		Partition
2		$3\frac{1}{2}$	$4\frac{3}{4}$		Cleats
2		$3\frac{1}{2}$	$3\frac{1}{2}$		"
1		$15\frac{1}{2}$			"
1		$18\frac{1}{4}$	$24\frac{1}{4}$		Top
1		$\frac{3}{8}$	$\frac{3}{8}$	6 ft.	Molding strip for top

All dimensions are in inches, except as noted.

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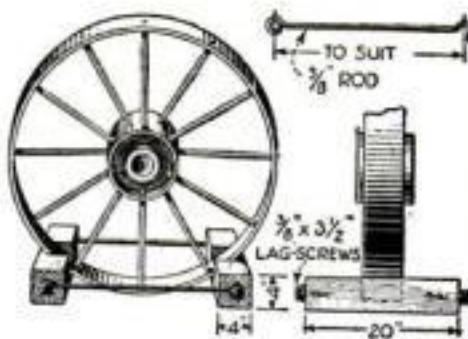
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The Home Workshop

How to Block the Wheels of Portable Farm Machines

FARMERS and other workers who deal with portable gas engines, hay balers, silo fillers, wood saws, and other machines mounted on wheels, will find it easy to block the machines so as to keep the belts tight with wheel trigs of the type illustrated. These have been used with perfect satisfaction in trigging wheels upon both wooden and concrete floors, as well as on the ground.

A set of the trigs may be made from 4 by 4 in. or larger blocks. Each pair of



A wheel "trig" for use on wood, concrete, and earth

blocks is held together with two hooks, which are fastened with lagscrews.

The wheel is raised with a jack or lever and the trig fitted beneath it. When the wheel is dropped, the weight of the machine forces the blocks into perfect contact with the floor.

By changing the length of the hooks, the blocks may be adapted for use with wheels of different sizes. If this is done it is more convenient to keep the rods separate by making a hook at each end instead of at only one end, as illustrated.—

CHARLES A. KING.

Stand for Baby's Bath

(Continued from page 103)

around the ellipse. The edge may be filed smooth or finished even more neatly by nailing a thin strip of wood to the edge and allowing it to project above the top about 1/8 in.

The corners of the top are sawed off as shown and the edge trimmed with a 3/8 by 1 in. molding strip. This is given a 1/8-in. chamfer after being nailed in place.

Sandpaper every part thoroughly and apply two coats of flat white paint and two coats of bathtub or refrigerator enamel, following the directions given on the cans. The flat surface of the molding may be painted a light blue and the panels and legs treated with a stenciled design, if so desired.

CHEAP picture frames can be refinished quite easily to resemble in general appearance much more expensive frames. Wash the frame with benzine and give it one or two coats of gold, Roman gold, or green-gold bronze powder mixed with bronzing liquid or banana oil. Obtain small tubes of burnt umber and cobalt blue artist's oil colors, thin a small quantity of each with turpentine or japan, and brush the colors on the frame so that they blend. Then rub the molding lightly with a cloth to remove the wet colors from the raised surfaces.



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Grid Gates are the Amsco improvement on "leaks." They provide measured and exact control of the current flow. Extra large for noiseless service. Fit all mountings. Insist upon Amsco Grid Gates, Amsco Resistors, Amsco Resistance Couplers. The latter are made with .006 condenser in genuine Bakelite base with mountings for two Resistors.



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charges discharged batteries instantly. Eliminates old sulphuric acid method entirely. Dissolves sulphation. World has waited half a century for this invention. One gallon retails \$10.00, free to agents.

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The Shipshape Home

Simply Made Sash Lock

ONE often wishes for a window lock that will be effective when either the lower or upper sash or both are partly open. Such a lock can be made from sheet iron or steel, as shown below.

Use any gage of metal from 20 to 23. Cut it out with a hacksaw and file it to the correct shape while flat. Then bend it through the center over a pair of vise



This wedge-like window lock is cut from a piece of sheet metal 2 in. wide and 2½ in. long

jaws. Finally bend the "thumbtack" points to the indicated angle with pliers.

The lock is fastened to the side rail of the upper sash in such a way that any attempt to move either sash results in the lock's being wedged tightly between the upper and lower sash and binding them fast. It is possible to leave either the upper or lower sash open 5 or 6 in., or the top and bottom 3 in. each.

The lock is a handicap to sneak thieves and prowlers, and also keeps youngsters from opening the window and perhaps falling out when they are left alone.—D. A. ROGERS, M.E.

Corrugated Fasteners

SO MANY jobs are clamoring for attention in the average house that the home worker should take advantage of all possible time-saving expedients. One of these is the use of corrugated fasteners. For some purposes corrugated fasteners are invaluable. They can be driven into joints in less time even than nails and when used with discretion they form a durable, foolproof reinforcement for common joints.

With their aid it is possible to reduce to an almost astonishing degree the time taken for making, for example, a pair of paneled doors for a kitchen cupboard, or a cellar window screen, or a preserve cupboard, or anything requiring frameworks that are to be painted afterward.

Corrugated fasteners come in several lengths, the ¼-, ¾-, and 5/8-in. sizes being

(Continued on page 107)



When this dredge started work the Mayor of Nome, Alaska, declared a holiday and all of the inhabitants attended.

The "Forty-Niner" of '26

Massive electric dredges now mine Alaskan gold. At almost incredible temperatures they dig 60 feet deep and scoop out 200,000 cubic yards a month.

From the Arctic regions to the Equator, G-E equipment is called upon to perform many hard tasks once done by hand but now better done by electricity.



General Electric supplied all electrical equipment for two such dredges now operating at Nome. A Diesel-electric power plant, four miles distant, furnishes the energy for a total of 592 h.p. in electric motors for each dredge.

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Hand Forged Razor Steel Blades, No. 57



A GENUINE \$2 KNIFE
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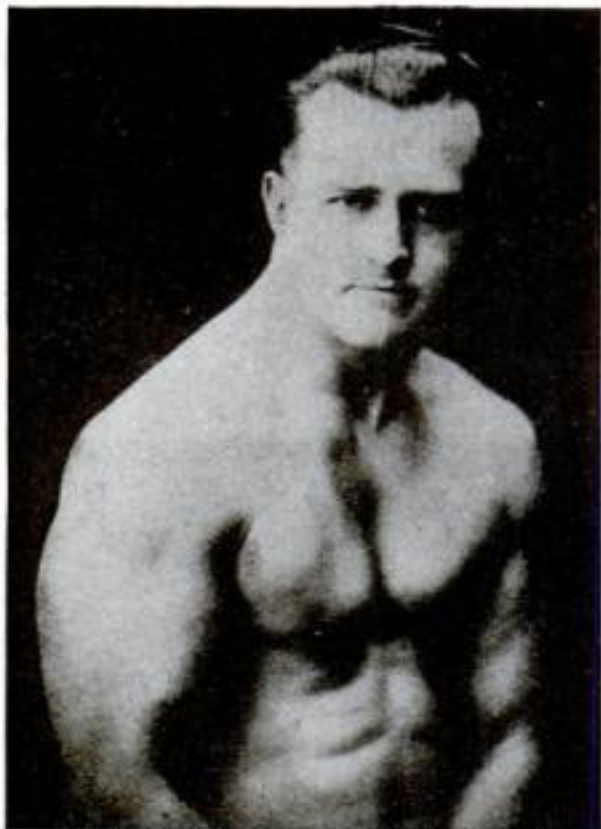
Hand Forged Razor Steel Blades

Handy shaped Blade makes this knife best for mechanics, sportsmen and farmers; light but strong; resharpened easily. Stag handle. German silver finish; blades file tested, hand forged from razor steel and warranted.

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"Secrets of Strength," "Here's Health," etc.

If You Were Dying To-night

and I offered something that would give you ten years more to live, would you take it? You'd grab it. Well, fellows, I've got it, but don't wait till you're dying or it won't do you a bit of good. It will then be too late. Right now is the time. To-morrow or any day, some disease will get you and if you have not equipped yourself to fight it off, you're gone. I don't claim to cure disease. I am not a medical doctor, but I'll put you in such condition that the doctor will starve to death waiting for you to take sick. Can you imagine a mosquito trying to bite a brick wall? A fine chance.

A Re-built Man

I like to get the weak ones. I delight in getting hold of a man who has been turned down as hopeless by others. It's easy enough to finish a task that's more than half done. But give me the weak, sickly chap and watch him grow stronger. That's what I like. It's fun to me because I know I can do it, and I like to give the other fellow the laugh. I don't simply give you a veneer of muscle that looks good to others. I work on you both inside and out. I not only put big massive arms and legs on you, but I build up those inner muscles that surround your vital organs. The kind that give you real pep and energy, the kind that fire you with ambition and the courage to tackle anything set before you.

All I Ask Is Ninety Days

Who says it takes years to get in shape? Show me the man who makes any such claims and I'll make him eat his words. I'll put one full inch on your arm in just 30 days. Yes, and two full inches on your chest in the same length of time. Meanwhile, I'm putting life and pep into your old back-bone. And from then on, just watch 'em grow. At the end of thirty days you won't know yourself. Your whole body will take on an entirely different appearance. But you're only started. Now come the real works. I've only built my foundation. I want just 60 days more (90 in all) and you'll make those friends of yours who think they're strong look like something the cat dragged in.

A Real Man

When I'm through with you you're a real man. The kind that can prove it. You will be able to do things you had thought impossible. And the beauty of it is you keep on going. Your deep full chest breathes in rich, pure air, stimulating your blood and making you just bubble over with vim and vitality. Your huge square shoulders and your massive muscular arms have that craving for the exercise of a regular he man. You have the flash to your eye and the pep to your step that will make you admired and sought after both in business and social world.

This is no idle prattle, fellows. If you doubt me, make me prove it. Go ahead, I like it. I have already done this for thousands of others and my records are unchallenged. What I have done for them, I will do for you. Come then, for time flies and every day counts. Let this very day be the beginning of new life to you.

"MUSCULAR DEVELOPMENT"

It Is Free

It contains over four dozen full-size photographs of myself and some of the many prize-winning pupils I have trained. Some of these came to me as pitiful weaklings, imploring me to help them. Look them over now and you will marvel at their present physiques. This book will prove an impetus and a real inspiration to you. It will thrill you through and through. All I ask is 10 cents to cover the cost of wrapping and mailing and it is yours to keep. This will not obligate you at all, but for the sake of your future health and happiness do not put it off. Send to-day—right now before you turn this page.

EARLE E. LIEDERMAN

305 Broadway Dept. 1302 New York City

Earle E. Liederman, Dept. 1302

305 Broadway, New York City

Dear Sir:—I enclose herewith 10c for which you are to send me, without any obligation on my part whatever, a copy of your latest book, "Muscular Development." (Please write or print plainly)

Name.....

Address.....

City.....State.....

The Shipshape Home

(Continued from page 105)

perhaps the most common. Their width is governed by the number of corrugations, which run from two to eight. The four, five and six sizes are the most generally useful, but the two and three sizes are valuable in holding the points of mitered joints.

Fasteners with saw-tooth edges are somewhat easier to drive than those with plain chisel edges. In some fasteners the corrugations are parallel and in others they diverge so as to have the effect of drawing the joint together as they are driven in. For general use the parallel type is the best, as it is not so apt to cause the joint to open on the under or opposite side.

If your hardware dealer does not stock corrugated fasteners, he can obtain them easily for you if you are sufficiently insistent. It will pay you to go to some effort to get at least 100 or 500 of the $\frac{3}{8}$ -in., No. 4 size fasteners.



Driving a fastener
in a mitered joint

Making kitchen cupboard doors—a job I had recently—affords a good illustration of the use of these fasteners. I mitered the ends of the rails and stiles from grooved stock in an accurate homemade miter box. White pine flooring, such as is used for outside porches, is excellent wood for this purpose, as it is grooved already, and the tongue can be cut off in a moment.

Pieces of wallboard were cut the right size for the panels and then one of the doors was assembled with glue on the bench. The mitered joints were held with corrugated fasteners driven in across them. As these frames were relatively heavy, two fasteners were used on each face of each corner. Care was taken to drive them in in such a way that a hole for a reinforcing dowel could be bored in each joint later on from the outside without having the bit strike the steel. It is important to take this precaution because if you strike one of these fasteners, you will damage your bit.

WHEN the glue in the mitered joint is hard, it is a simple matter to bore the dowel holes and glue in the dowels, taking care, of course, that each dowel is flattened a trifle with a plane to provide a small passageway for the escape of air and surplus glue. Otherwise the pressure may split the frame. Nails or screws can be used in place of dowels sometimes.

In building up wide boards, such as for table or bench tops, the corrugated fasteners may be used to reinforce joints on the under side. It is best, except for very rough work, to clamp or wedge the pieces together after they have been glued, and then drive in the fasteners while the boards are held flat and tightly together.

—RUFUS E. DEERING.

(Continued on page 107)

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\$600^a month

New Invention
No Competition

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IT

Act
Quick

Be First
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with this New
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Opportunity
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A MONTH
is his average
PROFIT**

Yes, \$1,000 a month profit! — that's what Richardson Baker, the Washington, D. C., CROWN FUEL SAVER distributor averages. He says orders come in so fast that four installers are busy. **YOU CAN DO WHAT BAKER IS DOING**—establish yourself in the paying, substantial, permanent business of distributing the

CROWN Fuel Saver and Smoke Abater

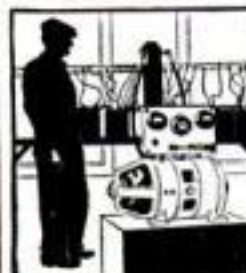
The same features which Baker finds so desirable will also appeal strongly to you. The CROWN sells easily because it is a great fundamental advance in the science of heating and the field is non-competitive. **WE GUARANTEE A FUEL SAVING OF AT LEAST 20%.**

WRITE TODAY! Now is the time to line up for the quick, easy cold-weather sales which can be made in your territory. Become the CROWN heating specialist in your vicinity. Big profits! Write to-day.

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HB One Day Charging starts you making big money recharging auto and radio batteries. \$150 to \$300 monthly profits easily made. Only \$35 cash brings complete HB One Day Battery Charging outfit. Easy payments. No experience needed. Lowest-priced complete (One Day Charging outfit on the market. 30 days' trial on money back guarantee. Write for free bulletin. HOBART BROS. CO. Box P226 Troy, Ohio

YOU CAN CLEAR \$150 to \$300

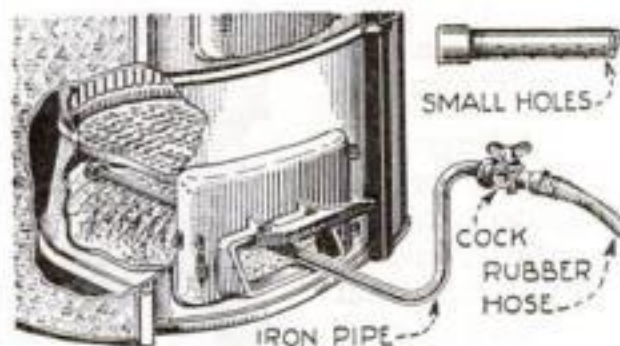
The Shipshape Home

(Continued from page 106)

Spray for Furnace Ashes

WHEN you remove ashes from a furnace, the dust flies all over the cellar and sometimes penetrates through small cracks to the floor above. Dampening the ashes while they lie in the ashpit will prevent this, but it is difficult to accomplish without damaging the grates and furnace with the surplus water.

One heating expert uses a simple home-made spray for wetting the ashes, and any one can make a similar device in a



Before the ashes are removed from the furnace pit, they are sprayed to stop the dust nuisance

short time. A length of $\frac{1}{2}$ -in. water pipe is bent in two places as illustrated. The end that is to go into the furnace is closed with a cap, and holes are drilled along the under side so as to throw a spray downward on the ashes. A garden hose cock is screwed on the other end and serves to connect the pipe with a rubber garden hose, which runs to the nearest source of water supply. The spray then can be used to dampen the ashes before they are removed from the furnace and also for moistening coal before shoveling it in, if the coal dust is troublesome.—G. E. S.

Repairing a Range Grate

THE breaking of a kitchen range grate is an annoying happening because the fire has to be let out until a stove mechanic comes to install a new grate and fire bricks. A satisfactory repair can be made immediately by using two bars of machine steel or cast iron $\frac{5}{8}$ or $\frac{3}{4}$ in. thick, 1 in. wide, and from 6 to 8 in. long. Four holes are drilled in these to take $\frac{5}{16}$ - or $\frac{3}{8}$ -in. carriage bolts. One bar is used above and the other below the broken grate, the bolts being placed so that the nuts come below the lower bar.

A repair of this kind has been used by the writer on several occasions and has served until it became necessary to replace the broken and burned fire bricks. It was necessary, however, to renew the bolts several times because the fire burned away the heads.—DR. H. J. BLAKE.

How to Polish Window Glass

WHILE newspapers are used generally in some sections of the country for polishing window panes, in other localities the value of this expedient is not appreciated. A crumpled sheet of newspaper leaves a brilliant finish, does not scratch the glass, is lintless, and does not spot up the surrounding woodwork.—GEORGE W. JOHNSON.

"Something better"

"LET ME SEE something better," says the customer—very frequently indeed. That something better in an automobile may cost several hundred or perhaps even several thousand dollars more; but in a cigarette it costs just three cents more

FATIMA



"What a whale of a difference
just a few cents make"

LIGGETT & MYERS TOBACCO CO.

\$100 IN CASH PRIZES

SEE PAGE 4 IN FRONT
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Your Own Snug Little Shop

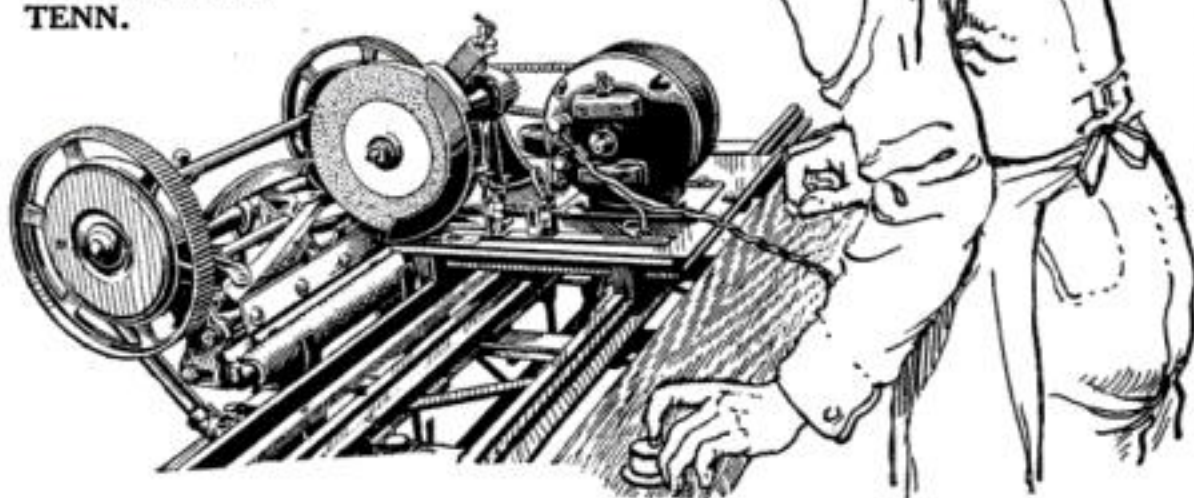
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GREENEVILLE,
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*Sure, Steady
Quick, Easy
Profits*

Better Shop Methods

Old Bill Says—

WHEN cutting threads, if the work is centered, be sure that the dog is tight before taking the first cut.

Help to keep your shop clean and shipshape.

Plenty of speed is a good thing, but it must be used with caution.

Never mind what the other fellow is doing, but concentrate on your own job.

Efficiency isn't a term to be frightened about; it simply means the easiest and quickest way to do anything.

Whenever you set up a job in the drill press, make sure that the drill will not go through into the table. This can be avoided by blocking the work up or setting the table so that the drill will enter one of the bolt slots as it breaks through the work.



Old Bill, machine shop foreman

It pays to take every precaution in protecting your eyes from injury. Don't let any Tom, Dick, or Harry try to remove particles of dirt or emery grit from your eye. It always is best and safest to seek skilled aid—and this can be said truthfully about all cases of injury where infection might result from improper care.

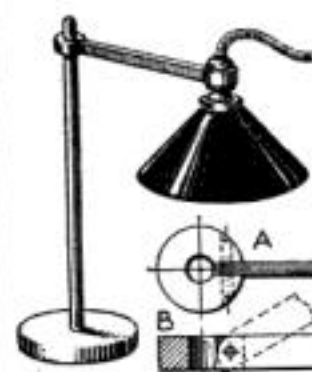
A twist drill will do much better work if ground on a machine than when it is guided by hand against a grinding wheel. It also will last longer between grindings.

Adjustable Lamp Bracket

THIS lamp bracket can be adjusted instantly with one hand. The standard is merely a round rod set in a heavy base. A free fitting collar slides on the rod and carries the extension bracket, which swings on a pin as shown at A.

The inner end of the bracket is filed eccentrically, as at B, to serve as an automatic clamp. Lifting the lamp a trifle releases the friction catch and frees the collar so that the bracket may be moved up or down, or turned.

—R. H. KASPER.



The bracket is locked by a simple eccentric

A new Parks!

Cabinet Shop Special

No. 7
\$250

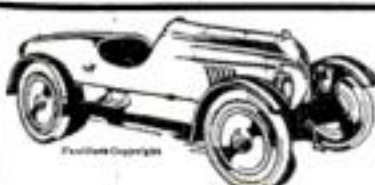


You ought to have this handy Parks in your shop!

A compact, complete machine designed just like a big production outfit at one-fifth the cost. Nothing extra to buy. Motor is included, operating from any light socket. Fits in a corner of your basement. Does any kind of cabinet and joinery work. Circular saw, jointer and bandsaw on permanent all-steel frame. Add lathe, shaper and other attachments at small cost. You can make money with this Parks! Write for circular.

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\$39.00 buys this RACEABOUT torpedo body in gray prime for your Ford. Special hood and bullet nose shell.

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AMERICAN TOP & BODY CO.
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The One-Profit WITTE Log Saw Does 10 Men's Work



Saws Wood Fast

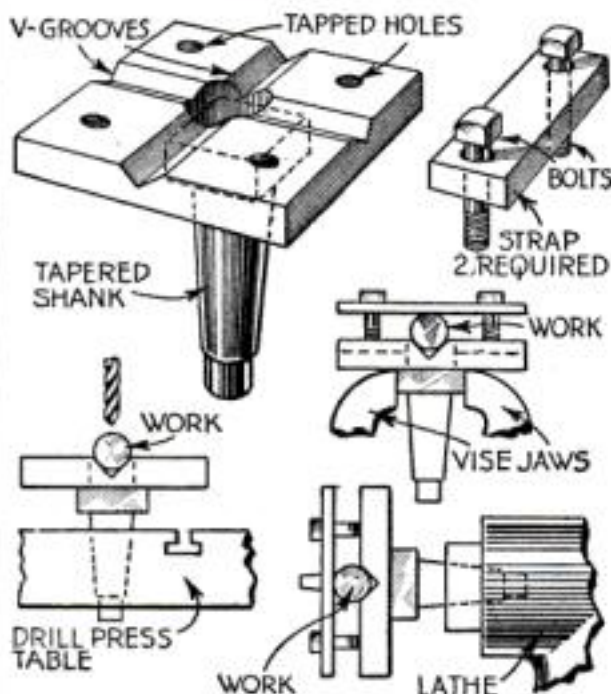
The WITTE Log Saw burns any fuel and will cut from 15 to 40 cords of wood a day. Easy to operate and move. Trouble-proof. Falls trees—makes ties—runs other farm machinery. Fast money maker and big labor saver. Completely equipped with Wico Magneto, speed and power regulator, throttling governor and 2 fly wheels. Write today for my big Free Book and Low Easy Payment Prices. No obligation. Or, if interested, ask for our Engine, 3-in-1 Saw Rig or Pump Catalogs.

WITTE ENGINE WORKS
7221 Witte Building, Kansas City, Mo.
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Better Shop Methods

Work Holder for Lathe, Drill Press, and Bench Vise

WHEN made with a taper shank, the work holder illustrated may be used to hold cylindrical pieces for drilling and tapping in the lathe, in a bench vise,



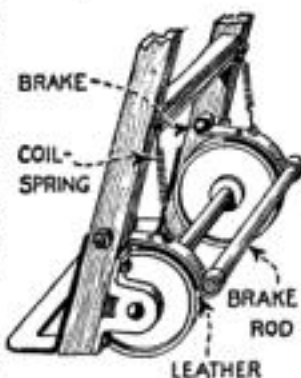
This work holder can be used interchangeably in a lathe, drill press, and bench vise

or on a drill press, provided the latter has a taper hole in the table. Both the holder and the clamps are made of machine steel, and can be of whatever size seems to fit the shop's needs.—G. A. L.

Brake Improves a Hand Truck

HANDLING heavy castings, boxes, pieces of machinery and other materials around a machine shop can be done with greater safety and speed if the two-wheel hand truck commonly used is fitted with a brake. When lifting a heavy load, one foot is placed on the brake-rod and the truck is held from running back while the load is "broken over."

The brake consists of a pair of brake shoes lined with leather and connected with a cross rod as shown. Two springs hold the brake away from the wheels except when the rod is pressed down.—W. P. MARKOWSKI.



Hand-truck brake

Straightening Warped Triangles

TO STRAIGHTEN a warped celluloid drafting triangle, place it between two pieces of 1-in.-thick hard wood that previously have been soaked in a pail of hot water for 10 minutes. Apply pressure by means of a copying press, a pile of weights, or any convenient method. Do not remove the triangle until it is cold. It will be found that the combination of moderate heat and pressure has restored the celluloid to its original flatness.

Look Sent on Approval

Adjusted to the Second; Adjusted to Temperature; Adjusted to Isochronism; Adjusted to Positions; 21 Ruby and Sapphire Jewels; 25 Year Gold Strata Case; Your choice of Dials; (Including Montgomery R. R. Dial); New Ideas in Thin Cases.

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We will send this famous watch, express prepaid, for you to examine, to inspect, to admire, to approve without one penny advance payment. Examine the watch and be convinced it's the best watch buy you ever saw. Just a small payment down, the balance in easy MONTHLY payments. You use the watch while paying for it.

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By purchasing this Famous Santa Fe Special Watch. Not only are you saving money from the present day prices of watches, but you can still secure the "Santa Fe Special" Watch, at the same low prices and terms that have made our watches famous.

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Artistic, dependable ladies' wrist watches—perfect timepieces, beautiful hand engraved cases in white or green gold. Send for New Watch Book and see the new shapes and designs. Sent on approval and sold on payments.

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Please send prepaid and without obligation your New Watch Book Free, explaining your "No Money Down" Offer on the Santa Fe Special Watch.

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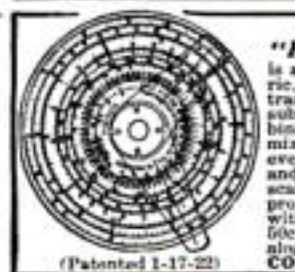
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Better Shop Methods

Torch Used to Remove Stone Roll from Steel Shaft

A GRANITE roll 19 ft. 2 in. long, used in a paper-making machine, was sent into the shop to have the stone replaced. Removing the old granite proved to be a difficult task. It looked as if the job

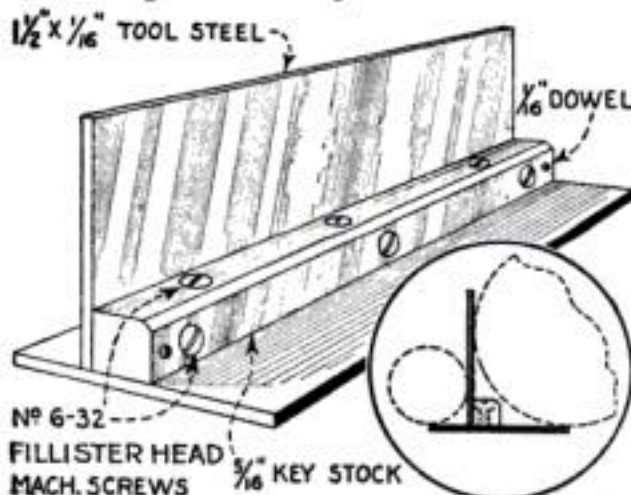


Under heat of a large fuel-oil torch the granite cracked and fell in large chunks from the steel

would take a week or more with air drills and hammers.

One idea suggested was to heat the roll with a large fuel-oil torch and then put cold water on the stone to crack it away from the shaft. This was tried, but it was not found necessary to use the cold water. After the torch had been applied for a few moments the granite began to crackle and fly off in small pieces, and large chunks of several pounds each dropped off until the shaft was free.—STANLEY W. BLANCHARD.

Improved Key-Seat Rule



KEY seats can be marked on both large and small shafts with the improved rule illustrated above. The auxiliary edge allows the rule to be applied to shafts less than $\frac{1}{2}$ in. in diameter.

The rule is made of ground templet stock $\frac{1}{16}$ by $1\frac{1}{2}$ in. and may be any desired length. Two pieces of equal width are joined together with a length of $\frac{5}{16}$ -in. key stock, six machine screws, and two dowel pins. The edges must be square and parallel.

Inspecting Grinding Wheels

IF YOU use grinding wheels of any kind, be sure they are mounted properly. Carelessness may result in serious injury. A grinding wheel never should be placed on a machine without careful inspection, because it may have a crack or hidden flaw. Wheel manufacturers subject their wheels to a rigid test for safety before leaving the factory, but the wheels may become damaged after leaving the factory. It is better to be safe than sorry.

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Bring in those distant programs clear and loud!

THE actual originators and world's oldest makers of loud speaking devices have created in The Amplion a long distance radio reproducer so clear and powerful that many users say it can be used instead of another tube in a set. Hear The Amplion—in comparison!—and you will understand the reason it leads in sales throughout the world—is the choice of the Royalty and Nobility abroad, and of the musically critical everywhere. Write for the "Amplion Pedigree."

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Supreme clarity of tone caused Amplions to be chosen for use in St. Peter's, Rome, to reproduce important papal ceremonies.

All Amplions are completely equipped with cords and panel plugs.

Speakers and console units

\$12 to \$4250

Better Shop Methods

Simple Clamping Fixture Aids in Soldering Small Parts

ONE difficulty in soldering small parts is that the iron is apt to push the work out of position. A small shop with much work of this kind to do uses the simple clamping fixture illustrated.



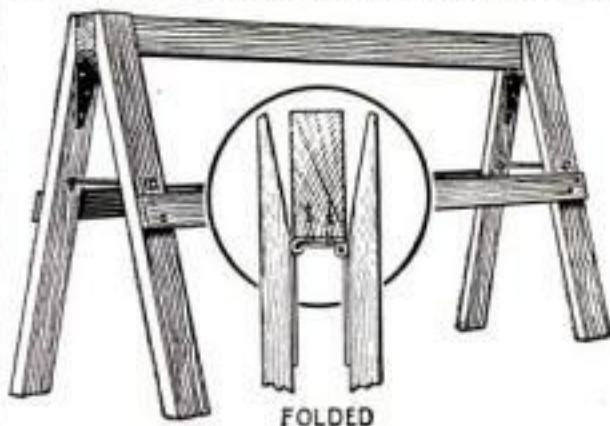
A soldering clamp

The body is a piece of 2-in.-round cold rolled steel about 6 in. long with a 3/4-in. hole drilled through it at right angles near the top. A piece of 3/4-in.-wide strap iron is pushed through this hole, bent up on each side, and further bent to cause the ends to overlap in the center. A hole is then drilled through the ends and a nut is brazed on top to carry the clamping screw.

With this arrangement all necessary light clamping can be done easily. The screw can be moved over to one side if necessary, as well as folded right down when out of use.—ARTHUR KENDALL.

Folding Horses for Platforms

LARGE wooden horses for supporting platforms such as those used by millwrights and builders are cumbersome to handle and require considerable floor



When not in use, this large horse can be folded up compactly for storage

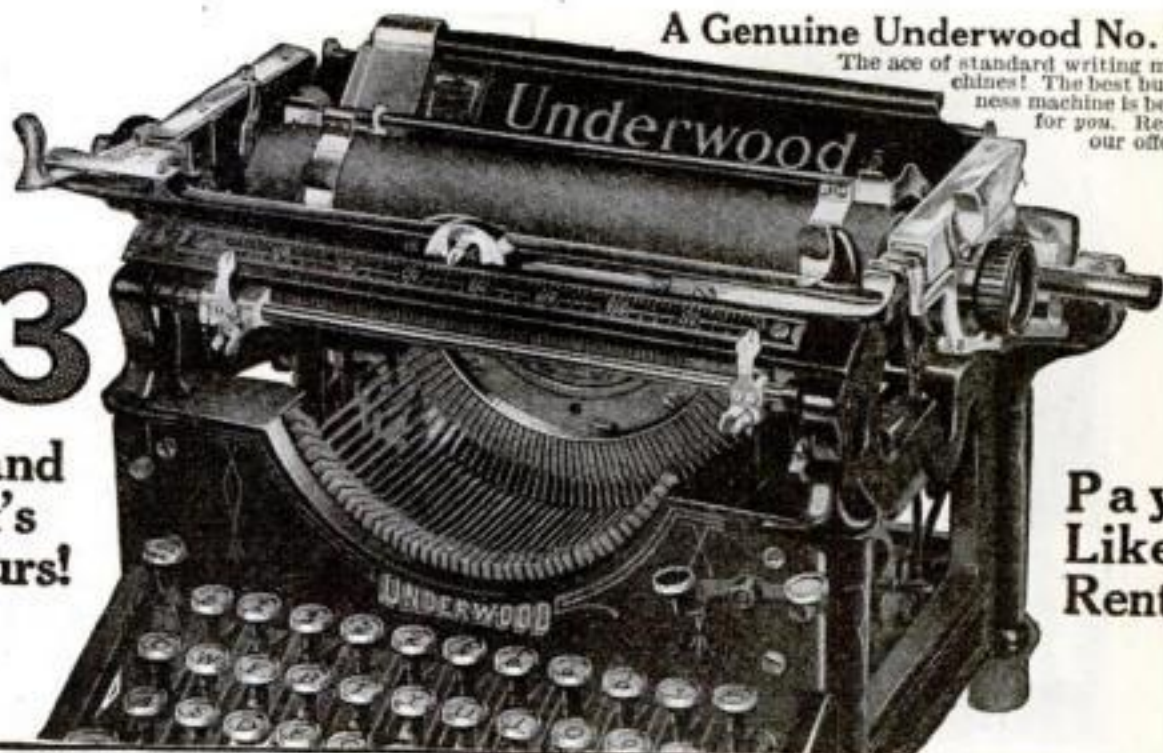
space for storage when not in use. The construction illustrated is designed to economize space. Incidentally, the horses are much easier to handle.

Large butt hinges are used to join the legs to the cross piece. When in use each pair of legs is held rigidly by a heavy iron hook.

Ways to Reduce the Moisture Film on Shop Goggles

MECHANICS who are troubled by the formation of a film of moisture on goggles will find that an application of glycerine soap on the glass will be helpful. Make a strong solution of soap and water and wipe the inside of the glasses with it. Some druggists and many opticians sell a commercial preparation that is even more effective.

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—and
It's
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30 Verses for Autograph Albums. All
the above by mail for 10 cts. and 2 cts.
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Getting Ahead?

Read the advertisements on Pages 118 to 154 this issue if you want to get ahead!

A 2c Stamp

—will start you on the road to success. See Money Making Opportunities on pages 118 to 154.

A SERVICE FOR YOU In Buying Radio and Tool Equipment

For list of tested and approved products write to the Popular Science Institute of Standards. See Page 6.

JUST OUT! GREEN, RED. SELLS FOR \$1.25. SAMPLE 67c



Unbreakable, TRIO Self-Filling Fountain Pens. Ideal Xmas Gift. Comes in Holly Box. Guaranteed for 2 Years. "It makes Carbon Copies." Money refunded if you do not think it is the best pen you ever wrote with. Finished in beautiful green, red, purple or black. Send for wholesale quantity price list and distributing plans.

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6 WEEKS AGO he clipped the coupon

Other fellows had left him in the social background. Girls avoided him. He was missing all the modern fun. Then one day he read an advertisement. It held a promise of popularity if he would learn to play a

BUESCHER

True Tone Saxophone

He thought himself musically dumb. Still, the ad said it was easy. He mailed the coupon, and later sent for a Saxophone for six days trial. Before the end of the week he was playing easy tunes. That was six weeks ago, and today he's "popularity" itself. He is always welcome, everywhere.

You can do it too! If you try

If you can whistle a tune you can master an easy fingering Buescher Saxophone. 3 lessons given on request, with each new Saxophone, teach scales in an hour and within a week you can be playing popular tunes. 304A

Six Days Trial - Easy Terms

Try any Buescher Instrument in your own home for six days. See what you can do. Satisfaction guaranteed or no sale. If you like the instrument pay a little each month. Play as you pay. Clip the coupon below. Send for beautiful book, "The Story of the Saxophone" or literature describing the instrument of your choice. Send it today. Get started.

BUESCHER BAND INSTRUMENT CO.

Everything in Band and Orchestra Instruments

1358 Buescher Block Elkhart, Indiana



This beautiful book gives the complete history of the Saxophone, and tells why the Buescher is so easy to learn to play. In it you will find the first lesson chart and many interesting pictures. You must have this fine book.

Clip the Coupon NOW!

Mail **BUESCHER BAND INSTRUMENT CO.**
1358 Buescher Block, Elkhart, Indiana.
Gentlemen: I am interested in instrument checked below:
Saxophone ☐ Cornet ☐ Trombone ☐ Trumpet ☐
Mention any other _____
Name _____
Street Address _____
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Better Shop Methods

How to Fit Piston Rings by the Peening Method

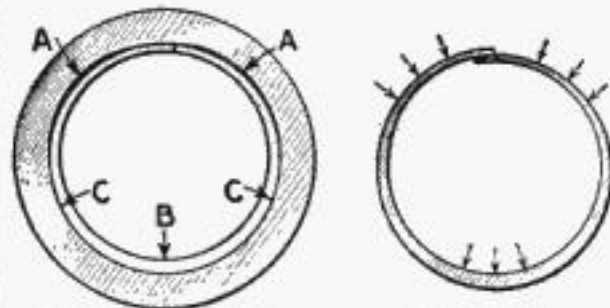
By HARRY B. MAXWELL

MANY manufacturers of motors, after cutting piston rings so that they will be a trifle over size when closed, insert them in a cylinder long enough to hold several rings, then clamp them between flanges on an arbor, slide off the cylinder, and turn the rings to size.

The diagram below shows a ring inside the cylinder ready to be clamped on the arbor for turning to the finished size. This diagram is exaggerated, but it illustrates the condition.

At the points marked *A* the ring does not touch the inside of the cylinder. This is because of the stress in the metal, and the difficulty is not relieved by turning to size. For that reason the ring bears harder at the point next to the cut in the ring and at the surface of the ring opposite *B*. The places *A* wear faster than the rest of the ring and after a little use the ring shows dark spots at the points marked *C* and leaks at those places.

To make a ring tight and insure that it will wear evenly, put it over an arbor and



Diagrams showing in exaggerated form where rings bear hardest and how topeen them

peen the outside at each side of the point *A*, so as to bring the point of the ring in a trifle, as shown in the view at the right. Do this to both sides and then bring the ring back to a perfect round by peening on the inside at the spot marked *B*. This will throw the points out and, if carefully done, will give a round ring that will require little fitting to insure a perfect seal.

To test a ring when fitting, rub Prussian blue in a very thin film on the outside. Insert it in the cylinder it is to be used in and rub to show the bearing.

Careful peening will make filing unnecessary. It is well to practice on some old rings first. Be sure not to hit too close to the edge of the ring. Use a light hammer and tap gently so that you can control the operation better.

This is the best way that rings for heavy duty air compressors and ammonia compressors can be fitted properly, so far as I know. You will be surprised what pep your motor will show when the rings are fitted in this manner.

In this article Mr. Maxwell opens an interesting field for discussion. Ray F. Kuns, the principal of the Cincinnati Automotive Trades School and the author of a long series of auto repair articles appearing in the Home Workshop Department, made these comments after reading Mr. Maxwell's suggestions:

(Continued on page 122)

The Loud Speaker Sensation!



Design Patented

The KODEL MICROPHONE LOUD SPEAKER

An exact replica of the transmitting microphone used in broadcasting stations.

The efficient KODEL SOUND UNIT, with an ingenious new snail-shell horn, mounted inside the microphone case, produces a remarkably clear, full-toned volume, with every note as rich and true as when it enters the transmitting microphone in the studio. Non-vibrating tone chamber absolutely eliminates distortion.

\$15 Model incorporates new Kodel, Jr. unit; with large Kodel unit, \$20.

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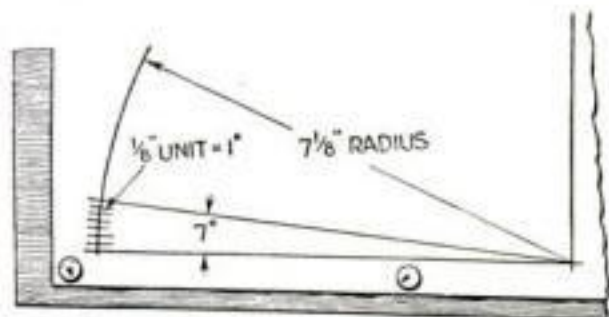
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Better Shop Methods

Laying Off Accurate Angles without a Protractor

DRAFTSMEN, mechanical or civil engineers, and mechanics often find it necessary to construct an angle of a given number of degrees, or to measure an angle of unknown span, without the aid of a protractor or other instrument for measuring angles. In such an emergency they will find the simple geometrical method described here highly useful and surprisingly accurate.

With a pair of drafting compasses describe a circle with a radius of 57.3 millimeters. Let us suppose that you have to construct an angle of seven degrees. Take a small divider, set the two points exactly one millimeter apart and then mark off carefully on the periphery of the circle seven of these one-millimeter parts. Connect the first and also the last of the marks



To find a 7-degree angle, simply lay off seven $\frac{1}{8}$ -in. spaces on an arc of $7\frac{1}{8}$ -in. radius

by straight lines with the center of the circle; the two lines will inclose an angle of exactly seven degrees.

No matter how large or how small the desired angle is, the same method may be used. The reason is quite simple. The arc of a complete circle measures 360 degrees. The periphery of a circle with a radius of 57.3 millimeters is 2 times π times 57.3, or 360.02 millimeters. Hence, every millimeter of the periphery is equal to an arc of one degree, with a negligible error of .02 millimeter for the entire circle.

Instead of millimeters, inches or fractions of inches (preferably $\frac{1}{4}$ or $\frac{1}{8}$ in.) may be used. If $\frac{1}{4}$ in. is chosen as the unit, the radius of the circle must have a length of $14\frac{1}{4}$ in. plus $\frac{3}{10}$ of $\frac{1}{4}$ in. Each $\frac{1}{4}$ in. of the periphery then will represent 1 degree. If $\frac{1}{8}$ in. is the unit, the circle must be drawn with a radius of $7\frac{1}{8}$ in. plus $\frac{3}{10}$ of $\frac{1}{8}$ in. Each $\frac{1}{8}$ in. of the periphery in this case will represent one degree. —ERNEST WELLECK.

Mounting a Faceplate

WHEN mounting a chuck or faceplate on the nose of a lathe spindle, the threaded hole should be inspected for chips or dirt. A thorough cleaning and a few drops of oil on the spindle nose often will save a lot of time when the chuck or faceplate is to be removed. Never force the faceplate on the spindle nose; if it goes on hard, there must be some obstruction. Unscrew the plate or chuck and look for the cause. It should go back tight against the shoulder of the spindle.

Right Resistance Meters

**Your Loud Speaker May Talk
But It Can't Tell You What's Wrong
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STERLING POCKET METERS ANSWER THESE QUESTIONS

What Voltage Should a NEW Dry B Battery Show?
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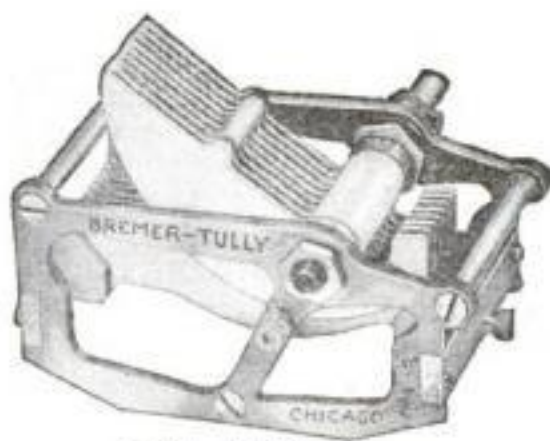
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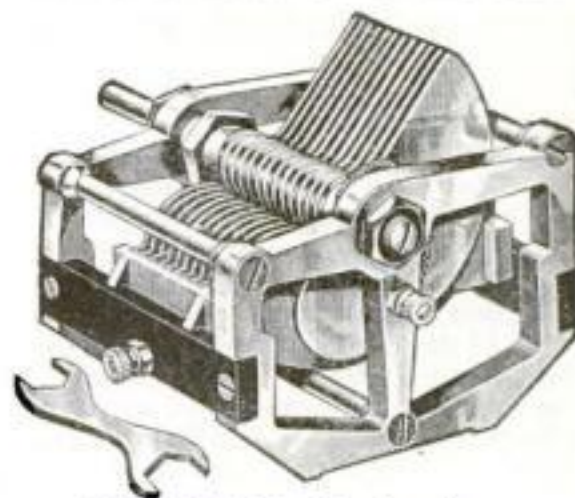


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"I catalog a number of the most highly advertised condensers," says a leading jobber, "but the only one I can sell is B-T. My dealers won't take anything else."

The dealer likes to sell what satisfies his customers, that's why.

**And the B-T LIFETIME
Condenser satisfies
because it delivers**

Before you buy, examine the B-T and we believe you'll agree it's what you need.

B-T products include

Audio and Air Core Transformers, Tuners, Vernier Dials, Sockets, Choke Coils, Variable Resistances, Potentiometers, Condensers in all styles, Nameless and Counterphase Kits, patented Toroid coils and

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They are all described in "Better Tuning," an 80-page book of Hook-ups and tuning information. Sent for 10c.

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The illustration pictures the take-off of the winning flight and in the insert is the radio equipment carried. (Burgess 'A', 'B' and 'C' Batteries furnished the electrical energy to operate the set.)

When the Goodyear III won the right to represent the United States at Belgium, Burgess Radio Batteries supplied the electrical energy for the operation of the balloon's radio equipment.

Almost every day from somewhere in the world news comes to us of new Burgess adventures.

And that Burgess Batteries have contributed their bit in so many interesting events of sport, commerce and science reflects the esteem in which they are held.

"Ask Any Radio Engineer"

Your own radio dealer down the street sells Burgess Batteries. He probably sells the famous Burgess Flashlights, too.

BURGESS BATTERY COMPANY
GENERAL SALES OFFICE: CHICAGO

Canadian Factories and Offices:
Niagara Falls and Winnipeg



Better Shop Methods

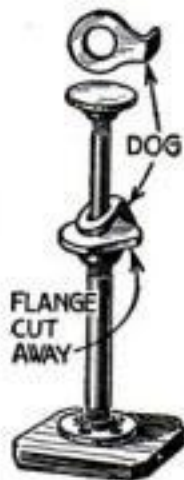
Utility Shop Stand Has Simple Adjustment for Height

IN EVERY shop there are times when an adjustable stand or table will save time and labor. Often when drilling an awkward piece of work, for instance, it is necessary to rest one end on a stand or have a helper hold it.

A useful stand for this purpose may be made as illustrated, chiefly from pipes and fittings. The lower part is a pipe of large



Using stand to support long work (at left); diagram illustrates the catch



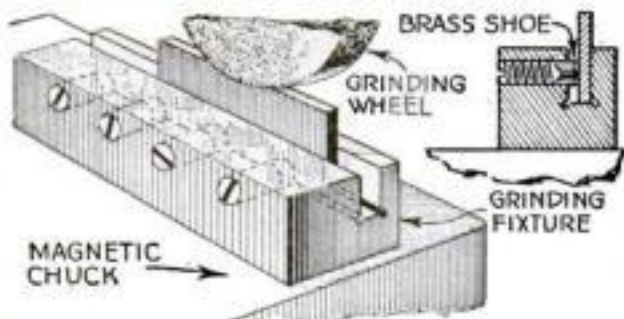
diameter with floor flanges screwed to each end. The lower flange is fastened to a wide wooden base.

A pipe that will slide inside the first pipe and of suitable length is fitted with a flange at one end. To this flange is fastened any desired type of top. A dog made as shown is slipped over the upper pipe before it is inserted in the lower part of the stand.

When pressure is brought to bear on the top of the stand, the dog will grip the smaller pipe and hold it firmly in any position. A portion of the upper flange of the stationary part of the stand is cut away so that a turn of the upper part will cause the dog to release its grip and allow the top to be lowered.—JONAS J. BYBERG.

Grinding Fixture for Gages

SHEET-STEEL gages and templets that are to be ground on the edges may be set up quickly with the aid of the simple fixture illustrated. The slot should



A simple fixture for holding sheet-steel gages and templets while they are being ground

be about $\frac{1}{4}$ in. wide to take the common sizes of gage stock. Usually the templet would be clamped on an angle plate, but this device makes clamps and angle plates unnecessary. The work may be removed quickly for measuring and reset without having to take the trouble of truing it up with an indicator.

to people with cold radiators



AIRID Air Valves make cold radiators hot. Attach easily to any steam radiator without tools—need no adjusting—never leak—make no noise. Sold at heating and plumbing stores. Only \$1.60.

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Just think! Through our amazing new plan you can get this \$2409 bungalow for only \$1606—a clear cut saving to you of \$803 or actually a third! We furnish you with the finest materials cut to fit direct from our mill—saving you big money on your lumber, mill-work and labor. Satisfaction guaranteed or your money back.

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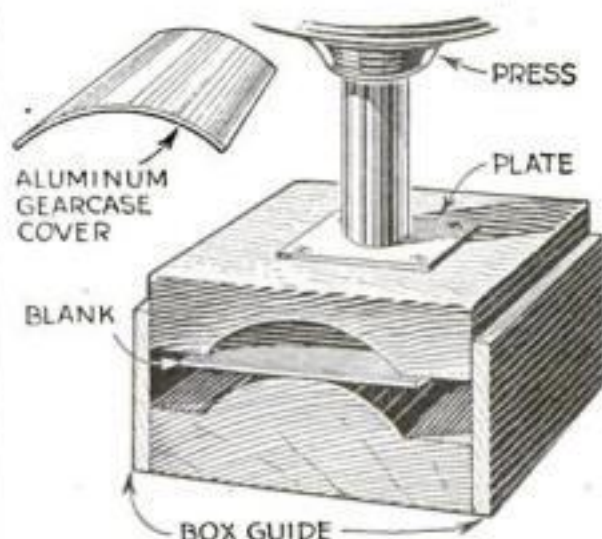
INTERNATIONAL MILL & TIMBER CO.
B-1 South Wenona Ave., Bay City, Michigan

Better Shop Methods

Wooden Forming Dies Serve for Experimental Work

FORMING dies of hard wood often are useful on experimental work, or where only a few pieces are to be made. The illustration gives the general idea of their construction.

In this case several aluminum gearcase covers were wanted, so top and bottom



A simple way to make forming dies of wood for shaping a few pieces of light sheet metal

dies were made of maple and the forming was done in an arbor press. The blocks of wood were sawed to the required shape and boards were nailed to the sides of the lower one to form guides. If the die is to be used several times, a steel plate can be put on top to receive the pressure of the arbor-press ram.

Forming dies of this kind can be used successfully on sheet steel up to about $\frac{1}{16}$ in.—H. L. W.

How to Make Neat Pipe Bends without Special Tools

WELL made curves or bends in pipe or tubing always are desirable in repair or experimental work, but without special tools they are somewhat difficult to form. In our shop we often make use of the idea shown in the accompanying photograph, which illustrates the steps in preparing a 90-degree angle.

Two V-notches are cut from one side of a piece of tubing or pipe of the desired size and just enough metal is left to hold the pieces in line until it has been bent. The width and number of the V-notches govern the angle of the finished bend.

By welding or brazing the joints, a satisfactory bend is produced and no tools aside from a hacksaw and welding torch are required.—EDWIN KILBURN.

GLASS may be filed easily if the work is done under water, and the file will not become dull so rapidly.



Three steps in making an angle bend

60 Days Ago They Called Me "BALDY"

Now my friends are amazed. They all ask me how I was able to grow new hair in such a short time

BOB MILLER and I had both been getting bald for years. We had tried almost every hair restorer on the market. But we might as well have used brass polish.

One day Bob left town—a business trip. Weeks passed. I began to wonder if I'd ever see him again.

One afternoon at the office I heard a familiar voice—"Hello, Baldy," it said. I glanced up, annoyed. There stood Bob.

"For Pete's sake!" I exclaimed, "where have you been keeping yourself?"

We shook hands. "Take off your hat," I suggested sarcastically. "Let me gaze on that 'luxuriant hair' of yours. I haven't seen it for weeks."

"Luxuriant hair is right," he retorted. "I've got the finest growth of hair you ever saw!"

I laughed out loud! "Know any more jokes," I said.

Bob stepped back and swept off his hat. I couldn't believe my eyes. The top of his head, once almost bare, was covered with a brand new growth of real, honest to goodness hair!

A New Way to Grow Hair

That night I went to Bob's house to try his new hair-growing treatment. He sat me in a chair and placed a strange apparatus on my head and turned on the electricity. The treatment lasted 15 minutes. At the end of the treatment I rubbed the top of my head. "Well, Bob," I chuckled, "I don't feel any new hair."

"Of course you don't," Bob came back. "But just you wait a while."

On my way home I read a booklet which Bob had given me. It described a new method of growing hair—discovered by Alois Merke, founder of the Merke Institute, Fifth Avenue, New York. It was the only treatment I ever heard of that got right down to the roots of the hair and awakened them to new activity. Bob was proof. I decided to send for the treatment immediately.

I Get the Surprise of My Life

Every night I spent 15 minutes taking the treatment. The first two or three days nothing happened. But I could feel my scalp beginning to tingle with new life—new vigor. Then one day when I looked in the mirror I got the thrill of a lifetime. All over my head a fine, downy fuzz was beginning to appear. At the end of a month you could hardly see a bald spot on my head. And after 60 days my worries about baldness were ended. I had gained an entirely new growth of healthy hair.



YOU CAN BUILD THIS IDEAL WORK-BENCH—YOURSELF

THE pleasure of working with tools at home is greatly increased if you have a strong substantial bench with a good vise. One that also has drawers and tool cabinets is a constant incentive to keep tools in order and give them the care and attention they deserve.

A blueprint of the Home Workbench illustrated, with full size details and bill of materials may be obtained by sending 25 cents to —

POPULAR SCIENCE MONTHLY
250 FOURTH AVENUE NEW YORK



Here's the Secret

According to Alois Merke, in most cases of loss of hair the hair roots are not dead, but merely dormant—temporarily asleep. To make a sickly tree grow you would not rub "growing fluid" on the leaves. You must nourish the roots. And it's exactly the same with the hair.

This new treatment, which Merke perfected after 17 years' experience in treating baldness, is the first and only practical method of getting right down to the hair roots and nourishing them.

At the Merke Institute many have paid as high as \$500 for the results secured through personal treatments. Yet now these very same results may be secured in any home in which there is electricity—at a cost of only a few cents a day.

Merke frankly admits that his treatment will not grow hair in every case. There are some cases nothing can help. But so many have regained hair this new way, that no matter how thin your hair may be, he invites you to try the treatment 30 days at his risk, and if it fails to grow hair then your money is instantly refunded. And you are the sole judge.

Coupon Brings You Full Details

This story is typical of the results that great numbers of people are securing with the Merke Treatment. "The New Way to Make Hair Grow" is a 34-page book which explains the Merke Treatment in detail. It will be sent you entirely free if you simply mail the coupon below.

This little book tells all about the amazing new treatment, shows what it has done for countless others, and contains valuable information about the hair and scalp. Remember, this book is yours free—to keep. And if you decide to take the treatment you can do so without risking a penny. So mail coupon now. Address Allied Merke Institute, Inc., Dept. 172, 512 Fifth Avenue, New York.

Allied Merke Institute, Inc.
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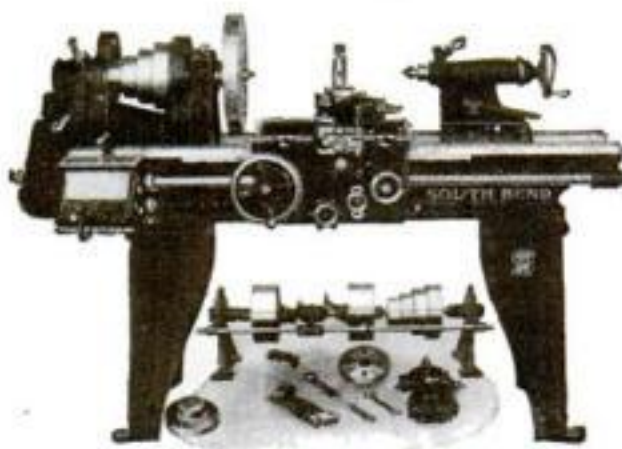
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The most complete, thoroughly practical and up-to-date treatise on the Diesel Engine ever published. It explains their construction troubles, remedies, operation and adjustments, practical trials and tests and the elementary thermodynamics of all types of the Diesel Engine. The book is fully illustrated with drawings of working parts and detail engravings. 400 pages.

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"LITTLE, but all there!" That's the Luther Vise—the neatest, huskiest little work pal you ever saw. No bigger than your fist in size, but strong as an ox when it comes to unyielding brawn. A genuine workshop tool with special features that make it as fine a general utility vise as is obtainable!

Has extra-heavy solid brass feed-screw nut; over-size steel feed screw; heavy, panelled slide bar; and wider jaw opening than any other vise of the same size. Four sizes: 1 1/2", 2", 2 1/2", and 3" jaw spread.

Write for free copy of Booklet,

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Either pin shown made with any 3 letters and 2 figures 1 or 2 colors enamel, Silver plate 25¢ ea. \$2.50 doz. Sterling silver, 40¢ ea. \$4.00 doz.

BASTIAN BROS. CO.

631 Bastian Bldg., Rochester, N. Y.

Free Leatherette Carrying Case Free with Big 3 Foot Wonder Telescope, 6 sections.

Brass bound, Powerful lenses. See people and objects miles away as if they were close. See moon and stars as never before. Useful and entertaining. "Could tell color of aeroplane 4 miles away."—Mrs. Yarbrough.

"Watch my boy arrive at school 2 miles away."—Mrs. Horn. "Read numbers on freight cars mile away."—A. C. Palmer. Thousands pleased.

Send No Money On arrival of Big 3 scope with FREE Case and Strap, deposit with Postman only \$1.85 plus few pennies postage. Satisfaction guaranteed or deposit returned. Order Now.

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LEPAGE'S will mend it



WHEN you wish to mend or repair any article of useful value, do not risk using a cheap or inferior glue. You would not sew a silk dress with cotton. Why mend a broken article with an inferior glue? The cost of LePage's is nothing compared to the saving of making permanent repairs. Use LePage's Glue, the standard for 40 years. Insist on LePage's.

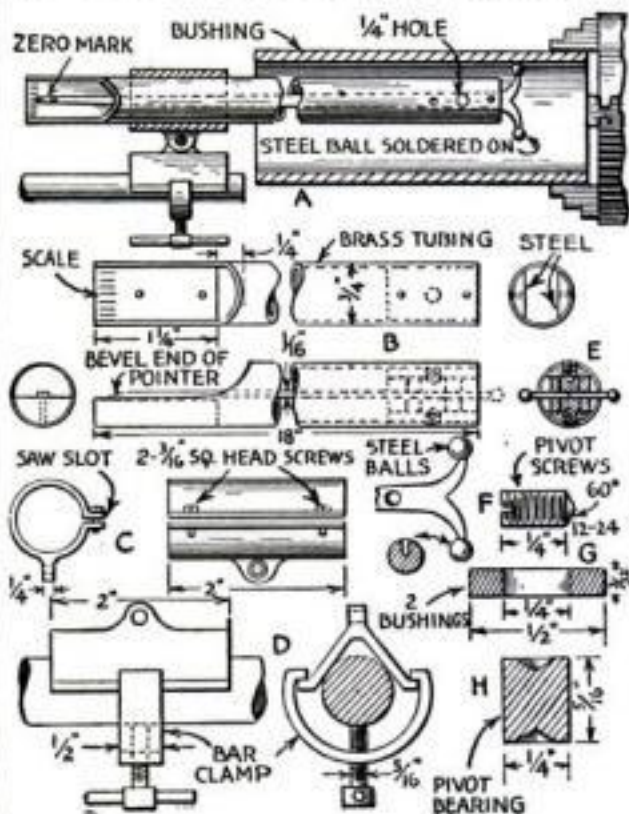
LEPAGE'S
GLUE

Better Shop Methods

Telltale Indicator Designed for Truing Deep Holes

IT IS easy to see if the front end of a hole in a bushing that is being set up in a lathe or grinder is true, but more difficult to tell whether the back end is perfectly true, especially if the hole is deep. The indicator shown in use truing up the bushing A is designed especially for this class of work.

The principal part is a piece of 5/8-in. brass tubing. A good length is 18 in., although it may be any other length to suit the shop's needs. It is milled a little below center on one end and a piece of 3/4-in. cold rolled steel split lengthwise is



How the indicator is used in truing up along bushing, and details of the parts

riveted in to form a scale. The steel should be polished with fine emery cloth.

At the other end of the tube two small pieces cut from 3/4-in. cold rolled steel are riveted inside with small countersunk rivets to form guides for the pivot bearing of the pointer, as shown at B.

The pointer is made from 1/8-in. sheet steel fitted with a pivot bearing made as at E. This consists of the pin H, two bushings G, pressed on either side of the pointer, and two pivot screws F.

A clamping arrangement for holding the indicator to a boring bar, or to a grinder spindle, is shown at C and D. The graduations on the scale may be made to read in thousandths by laying them off as accurately as possible while the ball end is moved .001 in. at a time by means of a micrometer.—H. L. WHEELER.

Hints on Tempering

SALT water will temper tools brittle. Soda water will temper them tough. To prevent steel from temper checking, use oil—fish or vegetable oil preferred. To use mild steel for tools, bake in bone meal from one to three hours. Then boil in cyanide of potassium and quench. For case-hardening parts, simply boil in cyanide and quench. To temper metal that is thin or difficult to heat evenly, heat in melted lead and quench.—M. E. S.



Read This Boy's Letter

"I am a boy twelve years old, in the 7th Grade. We had a lot of home work and I used to ask Dad about Geography, History and other subjects. Dad said, the subjects change so often, that he couldn't remember, so he helped me to look up the different subjects in our Nelson's Loose-Leaf Encyclopaedia. Now, I have the habit of looking things up for myself.

"Teacher noticed my answers were always correct and asked me who helped me. I told her Nelson's Encyclopaedia and she gave me an extra credit for looking up my own subjects.

"I also get a lot of information from Nelson's about Sports, Radio, Automobiles, and other things not in my home lessons."

Fred Leissing, Milwaukee, Wisconsin.

The BEST Encyclopaedia in the English Language

**BECAUSE:—it is 10 Years Later Than Any Other—
—it is ALWAYS NEW**

**Nelson's Loose-Leaf
Encyclopaedia is the Standard
Encyclopaedia of the World**

BECAUSE—

Nelson's patented Loose-Leaf Binding Device keeps it always new—it cannot grow old. Each six months, subscribers receive 250 or more new, rewritten pages to insert in the volumes in place of the pages that, because of the march of the world's progress and activities have become out of date. With this new Loose-Leaf Method you can *always be sure of your facts*. Never was there so much need for a complete and up to date fund of world knowledge as today.

Nelson's Reader's Guide— A College Education

It is not necessary to go to a university to get an education. A splendid education can be had on every subject taught in colleges and is within your grasp if you know how to obtain it. The Nelson's Reader's Guide consists of 33 full study courses based on the Encyclopaedia. It provides a course of

reading for every one, whatever his interests, from Aeronautics to Zoology. It is written in a human and absorbing style, compelling the reader's interest and making him eager to supplement his reading in the Encyclopaedia.

The Reader's Guide demonstrates the practical value of the Encyclopaedia to every member of the family—to the child or student in school—to the parent who would follow his child's interests and keep pace with his educational progress—to the man or woman in business or professional life—to *every one* who desires to be well informed in the subjects that go to make up a liberal education.

Fifteen minutes a day spent in reading the Loose-Leaf Encyclopaedia—with the aid of Nelson's Reader's Guide—will supply you with an education a college graduate could be proud of. Nelson's Encyclopaedia is a college education in twelve volumes—twelve volumes containing over 7,000 illustrations and overflowing with facts, knowledge and authoritative information on upwards of one million (1,000,000) topics.

Why Pay for Old, Obsolete Bound Volumes?

By the time an encyclopaedia composed of permanently bound volumes is delivered to you, it is anywhere from *five to fifteen years out of date!* And trying to bring it up to date by issuing supplementary volumes now and then is simply a makeshift, and a confusing one. The reader, struggling through several volumes and supplements, finds an uncorrelated mass of material and conflicting statements from which he must disentangle, as best he may, the information he requires. This old cumbersome method has given so much dissatisfaction that frequently two volumes are bound into one, but this only adds to the complexity. Why pay for a large percentage of out of date misinformation? The New Way—Nelson's Loose-Leaf Encyclopaedia—with no dead wood, brought up to date every six months—*saves you money, time, patience. It is the only really new and up to date Encyclopaedia obtainable at any price.*

Published in 12 Royal Octavo Volumes and Index Volume

Nelson's Free Research Bureau

FOR SCIENTIFIC REPORTS AND SPECIAL INFORMATION AND CORRESPONDENCE. Every purchaser of Nelson's is entitled to free membership in this Bureau. If at any time you are in doubt on any subject, old or new, write to this Bureau with the positive assurance that you will promptly receive the latest obtainable and most dependable information.

Mail the FREE Examination Coupon TODAY

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381 Fourth Avenue, New York City

Send me your portfolio of sample pages, beautifully illustrated, containing color maps, plates and photographs, and full information how, by easy monthly payments, I can own Nelson's Perpetual Loose-Leaf Encyclopaedia and receive FREE membership in Nelson's Research Service Bureau for special information. This must incur no obligation whatever on my part.

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Money Making Opportunities for "Popular Science" Readers



Readers of POPULAR SCIENCE MONTHLY will find scores of opportunities in this section (pages 118 to 154) for making more money.



ELECTRICITY

as Taught in COYNE Shops

**Puts You In the
Big-Pay Class
Quickly!**

HUNDREDS OF
COYNE-TRAINED
MEN EARN
\$60 to \$200
A WEEK!



Students
Constructing Outdoor
Substation at COYNE

**Earn While
You Learn
at COYNE**

My Employment Dept. helps you get a job to earn part or all of your expenses while training and assists you to a good job upon graduation.



Student Winding Stator at COYNE

**COMPLETE ELECTRICAL
TRAINING**

In 12 Happy Weeks at COYNE

My newly enlarged Electrical Course is the result of 27 years of experience, solving the needs of young men and of the Electrical Field. COYNE has been teaching Electricity in a PRACTICAL way since 1899. My course is thorough, easy to master, and fits men for BIG Electrical jobs, the HIGH-SALARIED thrilling jobs.



H. C. LEWIS
President, Coyne
Electrical School

**We Teach Electricity and
Nothing Else**

COYNE teaches only ONE thing—ELECTRICITY. We are SPECIALISTS. Our interests are not divided, nor is Electricity a sideline or merely an "additional" subject with us.

**You Can Start Any Day of
the Year at COYNE—No
Classes or Seasons. Get the
Coupon Mailed Right Away
so that You May Read Full
Particulars of My Course.
My Big FREE Book will
Amaze You!**

**You Don't Need
Advanced Education
or Experience to
Learn at COYNE**

Don't worry if you lack advanced education, knowledge of higher mathematics, or experience. My course is a practical, LEARN-BY-DOING Course. Every COYNE student receives INDIVIDUAL and PERSONAL instruction, on COMPLETE electrical apparatus, under EXPERT INSTRUCTORS, in the COYNE Shops at Chicago.



Students producing "artificial lightning" on Tesla coil in great shops of Coyne

Students operating large switch-board at Coyne

**Big Special Offer
If You Act NOW!**
I'll include with my course, without extra charge, my big Extra Courses in Radio Electricity and Auto, Truck and Tractor Electricity.



Send for Big FREE Book!

I want to send you a copy of my big, attractive Electrical Book. It is 12x15 in size and contains 151 photos of electrical scenes. Tells about dynamos, radios, autos, airplanes, farm lighting and power etc. Absolutely FREE. Remember.

SEND COUPON NOW

**H. C. LEWIS, President
COYNE ELECTRICAL SCHOOL
1300-10 W. Harrison St.
Dept. 1362, Chicago, Illinois**

Dear H. C.—You can just bet I want one of those big, handsome FREE 12 x 15 books, with 151 actual photographs printed in two colors. Send it quick, before the supply is exhausted. Be sure to tell me all about Special Courses without extra cost.

Name.....
Address.....

**It stands to reason: There is no substitute for
personal, practical training in great shops.**

Tune in on COYNE Radio Station WGES

**COYNE
ELECTRICAL SCHOOL**

H. C. LEWIS, President **Established 1899**

1300-10 W. Harrison St. Dept. 1362 Chicago
**There is no Substitute for Personal Training, in
Great Shops, on COMPLETE Apparatus**

Prize Winning Letters in the December Contest

The first prize of \$50 in the December Contest is awarded to a contractor and builder for his letter telling how the Chicago Technical College opened the door of opportunity for him. Mr. Bartholomew of Chino, Calif., says:

CONTEST EDITOR: On page 149 of the December POPULAR SCIENCE MONTHLY, is the ad of Chicago Technical College. This appeals to me as the best ad in "Money Making Opportunities."

A few years ago I was a struggling journeyman carpenter, averaging less than \$1500 per year. Having a desire to better myself, I enrolled for their Correspondence Course in Contracting and Building and in a short time, from the knowledge gained from home study, was in the contracting business for myself.

In a small town of about two thousand inhabitants, in one year I did a building business of nearly \$25,000, making nearly \$4,500 net profits. The Chicago Technical College offers any one who wants to follow construction work, who will apply themselves to home study, a Money Making Opportunity worth trying for.—W. L. BARTHOLOMEW, Chino, Calif.

From truck-driver to operator in a power station in eight months is the story E. C. Latimer, of Seattle, Wash., tells in the following letter, which wins the second prize of \$25.

DEAR SIR: Eight months ago I was a truck-driver working outside in all kinds of weather, barely making enough to buy the necessities of life for myself and family. Now I am a power station operator, doing congenial, fascinating work with lots of chances to learn and a salary allowing us a few luxuries. Naturally the advertisement which interests me most is the one that enabled me to do this—that of the Chicago Engineering Works.

I regard this as only a start. The most interesting part is the outlook for the future. Statistics show that the electric load in the Pacific Coast States is increasing twenty per cent a year, which means that in five years this industry will demand twice the number of men it now employs. To me this means unlimited opportunities, and due to this most interesting advertisement I will be prepared to grasp my share of them.

—E. C. LATIMER, Seattle, Wash.

(Continued on page 120)



J. E. Greenslade
President of the National Salesmen's Training Association.



\$5,000 to \$10,000 A Year Possible for Men Who Read This Ad

Let Me Make You a Master Salesman! This New Easy Way

I DON'T care what you are now or what you think. The Association of which I am president will take you in short, easy steps and make a Master Salesman of you, put you in the same class with the big pay men who have all the good things of life.

Many have thought that Salesmen were "born." And that idea has kept many men from succeeding. But this Association of Master Salesmen has proved that any man can be taught the rules and principles that make men Master Salesmen. And you know as well as I do that Salesmen top the list of money-makers. They are the producers and you can be one of them.

Easy as A, B, C

If you are as intelligent as the ordinary farmhand, postal clerk or stenographer, you can quickly master the simple A. B. C.'s of Selling. There are certain ways of approaching a prospect to get his undivided attention, certain ways to stimulate keen interest, certain ways to overcome objection, batter down prejudices, outwit competition and make the prospect act.

You can learn these principles at home in a short period of pleasant, inspiring study. And once you have mastered these secrets of Master Salesmanship, you can take advantage of the employment department of the Association without charge. They will help you select and secure a position as soon as you are qualified and ready.

This is a real opportunity, for during the last year the Association received calls for 49,880 salesmen from many of the leading sales organizations in America. And these men are the same as you see above—men who make from \$5,000 to \$10,000 a year in salary and commission.

These are only four out of hundreds of similar records in the Association files. Our members make good because the Association has specialized for eighteen years in teaching the Art and Science of Salesmanship and teaches the most unusual principles ever laid down for quick success.

The book you see below has been the starting point for thousands of men who are now successful salesmen. This book, "Modern Salesmanship," is now FREE and it will be sent to every man who fills out and returns the coupon below.

Rush the Coupon

If I were asking ten or twenty dollars for this book you might hesitate. But I am not. It is Free. And since it may mean the turning point in your life, when you leave forever behind you the drudgery and low pay of routine work for the fascinating, big pay job of the salesman, it certainly is worth your time and the two cents you will have to spend to get this amazing book and read for yourself the astonishing facts given between its two covers. You have everything to gain and not one cent to lose, so mail the coupon today, sure.

NATIONAL SALESMEN'S TRAINING ASSOCIATION
WORLD'S OLDEST AND LARGEST SALES TRAINING INSTITUTION

Dept. B-15

Chicago, Ill.

J. E. Greenslade, President
NATIONAL SALESMEN'S TRAINING ASS'N
Department B-15, N. S. T. A. Building
Chicago, Illinois.

Send me FREE your book "Modern Salesmanship" and proof that I can become a Master Salesman.

Name.....
Address.....
City..... State.....
Age..... Occupation.....

SENT FREE
the book that has shown
thousands the way to
amazing salary
increase



Building Draftsmen WANTED



\$9,000 in Four Months
"I have made \$9000 in 4 months on nine buildings" writes Wm. J. Petrasek, Chicago, Ill.

\$210 Per Month
"I am making \$210 per month as Architectural Draftsman. Thanks to Chicago Tech." Geo. E. Shafner, Haley, Tenn.

\$6,000,000,000 in Building

Train at Home for Big Money in This Fertile Field

Six Billion Dollars in one year! Think of it! Today Building is probably America's greatest and most profitable industry. Here is a field

whose future is insured by the normal growth in population and the industrial expansion of our country. There is a big building shortage now and many competent observers predict that our largest cities will be practically rebuilt in the next ten years due to ever higher standards of living. Six Billion Dollars spent each year in building means fortunes for thousands who have the vision to grasp the opportunity open now to get in on the ground floor.

Get Into Big Pay This Easy Way

Architectural or Building Draftsmen are needed everywhere. Get out of the low or moderate pay job. Step into a *real* job. You can do it with training in Architectural Drafting. Salaries are big because of the tremendous demand and the shortage of trained Building Draftsmen. Work is steady and you have a splendid chance to go into business for yourself. This

is the opportunity offered to you by this old established school of Architecture and Building Construction. Step out of the \$40 a week class. Learn how to earn \$50 to \$100 a week—and later \$5,000 to \$10,000 a year as chief or superintendent.

In Chicago Earn While You Learn



Chicago Tech. Building
Short Day or Evening Courses offered in Building Construction and Drafting in our Chicago School. Part time positions defray living expenses. 72-page "Blue Book" tells all. Ask for it if interested in coming to Chicago to attend the College.

Train at Home—Earn as You Learn

No need to quit your present job. Keep your present income and prepare for a bigger one. Our simple "Practice Plan Method" will qualify you quickly in your spare time. Into it has gone over 25 years of experience and the best knowledge of our large staff of architects and builders. It is simple, complete, resultful. Practical, successful builders guide you. Lessons in plain English. A common schooling is all you need. Get the facts now—today.

FREE TRIAL LESSON AND BLUE PRINTS

Just to show you how easy it is to learn Architectural Drafting by our method, we will send you a Trial Lesson and Blue Prints Free. Test yourself and see how you like the work. Send no money—just the coupon. Get this Free Lesson now with our Big Book of Opportunity also free. Make your first step today—it costs you nothing.

This \$25.00 Drawing Outfit

Sent without extra cost. Good for a lifetime. Mail the coupon and learn how to secure this valuable outfit.



CHICAGO TECHNICAL COLLEGE

Dept. 231, Chicago Technical Bldg.
118 E. 26th St. Chicago, Ill.



MAIL COUPON TODAY

Chicago Tech. College, Dept. 231, Chicago Tech. Bldg., 118 East 26th St., Chicago, Ill.

Send me, without obligation, your Free Trial Lesson, Blue Prints and Book of Opportunity. I want to know how to become a Building Draftsman.

NAME

ADDRESS

CITY OR TOWN STATE

Prize Winning Letters in the December Contest

(Continued from page 118)

Recreation, plus a handsome profit, was the experience of this POPULAR SCIENCE MONTHLY reader who saw his opportunity and took advantage of it. Mr. John H. Remick of Braintree, Mass., is awarded the third prize of \$10 for this letter.

DEAR EDITOR: The advertisement of Theo Audel & Co., in your December issue of POPULAR SCIENCE MONTHLY is of interest to me because their Carpenters' and Builders' Guides were a help in building entirely alone (with the exception of the rough plumbing) a four-room bungalow just outside of Los Angeles, Calif.

Although it required nearly a year to build the house, as I could work on it only evenings, Saturday afternoons, and a two weeks' vacation, I was able to sell and make a good profit, enough to pay expenses of the trip to the West Coast and return.

Prior to building this little home I had had no experience as a builder, having always been employed in electric light and power work. During the period required in completing the house, I was working through the day, using a pen and my brain, while the evenings were spent using a hammer or saw and my muscles.—JOHN H. REMICK, East Braintree, Mass.

Complete List of

Prize Winners

In the December Contest

FIRST PRIZE \$50

W. L. Bartholomew, Chino, Calif.
(Chicago Technical College)

SECOND PRIZE \$25

E. C. Latimer, Seattle, Wash.
(Chicago Engineering Works)

THIRD PRIZE \$10

J. H. Remick, East Braintree, Mass.
(Theo Audel & Co.)

PRIZE WINNERS who received \$1.00 each for their letters—

C. Torres, San Lorenzo, P. R.
American School

C. W. Claussen, Riverside, Calif.
Ralston University Press

Isaac L. Lerew, Portia, Kan.
Coyne Electrical School

William T. Tweedell, Meriden, Conn.
Davey Tree Expert Co., Inc.

Frank G. Davis, Harrisonburg, Va.
International Textbook Co.

L. E. Cannon, Dawson, Ga.
Moler System of Colleges

J. A. Lambert, Cape May Court House, N. J.
La Salle Extension University

S. P. Verner, Brevard, N. C.
Davey Tree Expert Co., Inc.

Perry F. Haines, Tidioute, Penn.
Paul Von Boeckmann

Francisco Miro, Maricao, P. R.
The Well Company

Raymond A. Kennedy, Canandaigua, N. Y.
Bureau of Inventive Science

Sherman E. Miller, Corry, Pa.
Meriden Press

Levis O. Jones, Johnstown, Fla.
National Salesmen's Training Ass'n.

E. Chenoweth, Lynn, Ind.
Landon School of Cartooning

Joseph Canganan, Cluny, Alberta, Can.
McSweeney Shops



800% Pay Increase

"Thanks to you and your Course, I now make 8 times what I earned when I enrolled." Carroll Moeschler, Chaska, Minn.



\$800 to \$1000 a Month

"I thought you couldn't teach me by mail, but you did. I make \$800 to \$1000 every month now." John Jirinec, Astoria, L. I., New York.



Gets \$125 a Week

"I earned \$25 to \$30 a week when I started your Course. Now I draw \$125." Walter J. Merfert, 1438 Springfield Ave., Irvington, New Jersey.



100% Pay Boost

"I am strong for L. L. Cooke—just got a 100% boost in pay." Harry A. Jones, 2934 Lincoln Ave., Chicago, Ill.



\$750 in Spare Time

"Since enrolling with you I made over \$750 in Spare Time work—10 times what your course cost me." John Burke, 4300 E. Lombard St., Baltimore, Md.



300% Raise in Pay

"Tell 'em to write me if they want to know about your course. You boosted my pay 3 times." Carl Everett, R.F. D. No. 6, Danville, Illinois.



Over \$750 a Month

"Thank you for my success. I am making over \$750 a month now." W. E. Pence, Albany, Oregon.



They Said It Couldn't Be Done But These 14 Men Did It—with COOKE Training!

Here are 14 out of thousands of men who earn \$3500 to \$10,000 a year in electricity. Not long ago they earned \$20 to \$30 a week. Friends told them they couldn't learn electricity at home—if they did learn it they couldn't get a good job. But the joy killers couldn't stop them. They did learn—they did step into big pay jobs. Now many of them earn as much in a day as their untrained friends earn in a week.

\$3,500 to \$10,000 a Year! That's what Thousands of Cooke Trained Men Earn in ELECTRICITY

What do you earn? Are you going to admit these fellows are smarter than you—even though they are not? You can do what these 14 and thousands of other men have done. Cooke Training is the quick, sure and easy way to big jobs in electricity. Lack of education or experience doesn't bar anyone. Mail the coupon for my big free book which tells all about it. Find out why the Cooke Trained Man is the Big Pay man in Electricity—why great engineers and employers endorse this training.

Why Cooke Students Are So Successful

The better the teacher, the better the results you get from training. That's why my "boys" make good. That's why the Cooke Trained Man is the Big Pay Man, the world over. As Chief Engineer of the famous Chicago Engineering Works I know from actual experience exactly what training you need to become a Big Pay Man in Electricity. And I give you that training along with SIX BIG ELECTRICAL WORKING OUTFITS to help you learn more quickly.

But that isn't all. My Course also includes Employment Service, Engineering Consulting Service, Elec-

trical Magazines, Use of my Electrical Laboratory, Special Earn while you Learn Instruction and many other wonderful features, at no extra cost. Send Coupon for my Big Free Book telling all about Cooke Training and your opportunities in Electricity.

I Guarantee Your Satisfaction

So sure am I that you can learn Electricity—so sure am I that after working with me you, too, can get into the "big pay" class in Electrical work—that I guarantee under bond to return every penny paid me in tuition if when you have finished my Course you are not satisfied it was the best investment you have ever made. No guarantee could be more fair than this. It proves I mean business—that I want you to succeed.

Send This Coupon NOW

Decide for yourself whether Electricity is the field for you. Don't take anybody else's word for it. Rush me the coupon for "The Vital Facts about Electricity," my great FREE Book of 100 pictures and facts about Big Pay. It places you under no obligation. No salesman will call—I don't do business that way. Within 48 hours you will know what YOUR opportunities are and how you can make good in Electricity. Send the Coupon NOW!

L. L. COOKE, Chief Engineer
Chicago Engineering Works
Dept. 32 2150 Lawrence Ave., Chicago



Here's the book that started these 14 men on the Road to Success. Your copy is ready. Mail the Coupon—TODAY!

CUT OUT AND MAIL FOR FREE BOOK!

L. L. COOKE, Chief Engineer
CHICAGO ENGINEERING WORKS
Dept. 32, 2150 Lawrence Ave., Chicago, Ill.

Send me your book showing how I may become an Electrical Expert and proof that you have trained men who are now earning \$3500 to \$10,000 a year. This does not obligate me in any way and no agent will call on me.

Name

Address

City State

\$700 in 24 Days

"I made \$700 in 24 days—Thanks to your training." Fred G. McNabb, 7 W. 16th Street, Atlanta, Georgia.



\$70 to \$80 a Week

"Your lessons are a real joy. I make \$70 to \$80 a week now." R. Jacquot, Colorado Springs, Colo.



\$500 a Month

"Use my name as a reference. I average better than \$500 a month." A. Schreck, Phoenix, Arizona.



Gets 50% Raise

"I owe my present position to you. My salary has increased 50% already." Arnold Schultz, 214 Madison Ave., Dixon, Illinois.



\$75 to \$150 a Week

"I didn't know a thing about Electricity—now I'm foreman of our shop and clean up \$75 to \$150 a week." E. Tokarz, Ft. Grand Hotel, Detroit.



\$12,000 Business in 8 Months

"My farm lighting plant business averages \$1500 a month. Your Course is the best." W. A. Saxon, 120 W. Clark, Albert Lea, Minn.



\$5000 a Year

"Since I started your Course 18 months ago I jumped from \$5 a day to \$5000 a year." A. F. Klemz, 14870 Cloverdale, Detroit, Michigan.

The Cooke Trained Man is the Big Pay Man

CHOOSE YOUR JOB!

HOME WORKERS' SERVICES.

DRAFTSMAN—BEGINNER, TO MAKE TRACINGS in spare time. Simple work, good pay. Bring samples. Knight Iron Works, Ard. & Park.

ARCHITECTURAL DRAFTSMEN—TO HELP evenings during rush. Work may be taken home. Call Elder, 1941.

DRAFTSMEN

Four students can get part, exp. in time; will select 2 for perm. post. for \$60 week to start. Mr. H. Chas. Cheny & Hicks, Garland 10 a m.

WANTED—MALE HELP.

Professions and Trades.

ARCHITECTURAL

ERS AND DRA

High class, on l

bank building

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WANTED—MALE HELP.

Professions and Trades.

DRAFTSMAN—AT ONCE—WHO CAN DO

good lettering; Younger man preferred.

Experience not necessary. Exceptional opportunity in pleasant office. Apply Saturday or Monday morning, Room 348 1st National Bank Bldg.

DRAFTSMAN

\$400 Month

Excellent opportunity for

man to become shop

live in short time if

his worth. I

office in new bu

hours; Dobe

will get prefer

KINDRED PRODUCTS CO.

MR. ORRINGTON

DRAFTSMAN—TO DESIGN TOOLS, JIGS,

fixtures, punches and dies; good pay, steady

position to right man. Call for personal inter-

view. Hill Pump Valve Co., 2307 Archer-st.

DRAFTSMAN—DETAILER, ON HIGH CLASS

cabinet work, bank and store; exp. req.

positions; factory location Indiana; call

Mr. DUGAN, Room 3200, 4-12

DRAFTSMAN—DETAILER, ON HIGH

class work, bank and store; exp. req.

positions; factory location Indiana; call

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positions; factory location Indiana; call

Mr. DUGAN, Room 3200, 4-12

DRAFTSMAN—DETAILER, ON HIGH

class work, bank and store; exp. req.

positions; factory location Indiana; call

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WANTED—MALE HELP.

Professions and Trades.

DRAFTSMAN—MACHINE DETAILER AND

tracer, \$80 wk., Fisher Bldg.

DRAFTSMAN—FOR ORNAMENTAL AND

decorative iron work; must be good de-

tailer; good job for right party. Call Mon-

day on J. GOLDBERG, Atlantic Hotel.

DRAFTSMAN

DETROIT EDISON

ELECTRICAL MEN WITH POWER HOUSE

AND SUBSTATION LAYOUT EXPERIENCE.

GOOD OPPORTUNITY AND STEADY EM-

LOYMENT. STATE AGE, EXPERIENCE

AND SALARY DESIRED.

THE DETROIT EDISON COMPANY

DETROIT, MICHIGAN

DRAFTSMEN

BEGINNERS

\$50 Month and Bonus

We want four clean cut

young men who have just

finished a good drafting

course to fill vacancies cre-

ated by us in our

St. Dobe

Excellent

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Better Shop Methods

How to Fit Piston Rings

(Continued from page 112)

Looking at the matter from the manufacturer's standpoint, it is desirable to turn out rings that will lie in a circle and thus conform to the cylinder. It is possible to buy any number of makes of rings that will lie properly in a cylinder with a true bore. On the other hand, it is possible to get rings that behave as indicated by Mr. Maxwell and then the thing to do is to peen them.

There are many things that can happen when an amateur or even the average repairman attempts to peen a ring. He can twist it, warp it, strain it, or even break it. For this reason many garages make a practice of lapping the ring to the cylinder into which it is to be fitted.

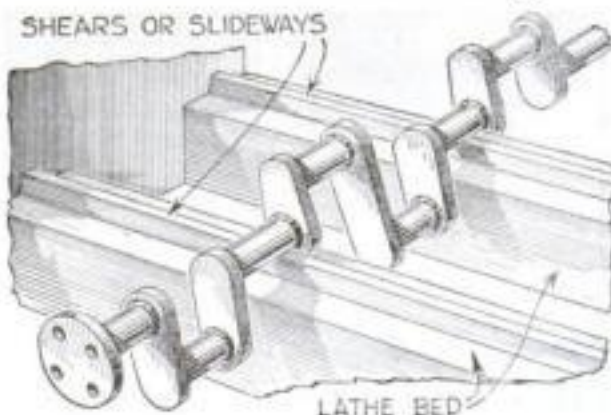
I like a ring so made that it will lie in the cylinder without any hand peening. If it doesn't fit, it may be that the cylinder is out. In that case, it is best to hone the cylinder. I also like rings that are rough turned with a round-nose tool. This leaves edges on the ring, which wear rapidly in service and thus have a self-seating effect.

Once upon a time I made up a set of rings for a car by turning them on the lathe, boring them inside, and finally using a cut-off tool to cut them to the proper face widths. I made up a number of extra ones, because I knew that some might be broken when I tried to peen them to a fit. I needed the extra ones and also a lot of patience. When the job was finished, however, it had compression! After eight years it still had compression in each cylinder.

The casting from which these rings were made was about $\frac{5}{16}$ in. larger in diameter than the bore of the engine and there was a decided expansion pressure when they were installed.

As this is a subject that can be approached from many different viewpoints, the Editor of the Better Shop Methods Department will be glad to hear from readers who have made a specialty of fitting piston rings and wish to comment on the suggestions given by Mr. Maxwell and Mr. Kuns.

Lathe Bed for Balancing



IF ONE of the shop's lathes has the bed leveled very carefully and the shears are kept free from dents, there always is available a good place to balance crankshafts, flywheel assemblies, grinding wheels, or other parts that must revolve without vibration.—G. A. L.

Easy Money! Geo. Frentress, a last year's student, "hard" at work on the job now paying him \$375 per month. A drafting position isn't difficult after the Dobe course; it's the same work

Follow the line of work you like, but learn the right end. It's draftsmen all concerns are after. Read the papers!

DO YOU realize what a big field drafting is? All building, engineering, or manufacturing starts on paper. Single jobs require thousands of drawings. The simplest things you use were drawn before they could be made; the tools you handle; even the pipe you smoke. Everything you see around you was first a drawing.

Here is your chance to take up drafting. You take my course right at home. I provide all the equipment that's required. We don't use books, but instruments. Drafting is all done with tools. So it doesn't call for "talent." Scores of engineering firms and manufacturers recruit their draftsmen from

Chief
Engineer
DunlapI will make this contract
with you—Your name here Wm. C. Campbell
When you enroll for my home-training
in ELECTRICITY I agree to give you:

1. Complete training, including Electrical Engineering, Ignition, Radio, etc.
2. Four outfits of standard tools and materials, including a \$10 motor.

3. I WILL HELP YOU GET A GOOD JOB AND A RAISE IN PAY.
4. —or I will refund every cent of your money.

By Chief Engineer Dunlap
AMERICAN SCHOOLElectrical
Home TrainingNow Backed with **FREE JOB SERVICE**

I am pushing thousands of men ahead to success in Electricity by a wonderful new method of home-training. Now we announce a new feature for students and graduates of the American School—a nation-wide Employment Service under the direction of Mr. A. H. Burgkart, Job Expert. Burgkart is placing men in fine Electrical positions as fast as they qualify. The Electrical business needs more Experts. Go into Electricity and you're sure to find a good job when you're ready for it. You can get ready with Dunlap Job-Method training:

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We guarantee this training up-to-date and complete. Without extra charge I give you Electrical Engineering subjects, Electrical Drafting, Ignition, Radio, and many business subjects.

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This is no one-man, one-idea school. America's greatest Electrical Engineers helped me prepare this training, and their work vouches for its high standard and thoroughness.

Instructions prepared by men from:

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| 1. General Electric Co. | 7. Western Electric Co. |
| 2. Commonwealth Edison | 8. Underwriters Lab. |
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| 4. Cutler-Hammer Mfg. | 10. Dartmouth College |
| 5. American Telephone & Telegraph Co. | 11. Massachusetts Inst. |
| 6. Westinghouse Electric & Mfg. Co. | 12. Lehigh University |
| | 13. University of Vermont |
| | 14. Armour Institute |
| | 15. University of Kansas |

Small Monthly Payments

Our educational standards are high, tuition is within reach of the untrained man who needs this training, and small monthly payments accepted. So you need not face the world without training—let me show you how to get this million dollar No-Profit institution back of you in your fight for success and independence.

Get My JOB AND RAISE Offer—Quick!

Now you can put your time and money into home-training with a positive knowledge that it will lead to a better job and increased pay. Get the facts about my amazing offer. Find out about the opportunities and jobs waiting for you in Electricity. Act quickly and make the next few months the turning point in your life. Coupon brings complete information.

CHIEF ENGINEER DUNLAP,
Electrical Division

AMERICAN SCHOOL, Dept. E-275

Drexel Ave. & 58th St., Chicago

3.—

because I train you
by the Job-Method

These pictures show how my students learn Electricity by doing actual Electrical jobs with standard materials and tools which I supply without extra cost. **Four costly outfits given!** Students make fast progress by this wonderful Job-Method. Many do similar jobs for pay in their spare time and earn more than enough to pay for this training.

The Fourth Outfit is a
Standard Radio Set
which you must assemble
from regular air-

Send JOB and RAISE Offer

To.....
St. No.....
City..... State.....

(Mail immediately to Chief Engineer Dunlap, American School,
Dept. E-275, Drexel Ave. and 58th St., Chicago)

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FREE trial, marvelous new adding machine. Adds, subtracts, multiplies, divides automatically. Work equals \$350.00 machine. Price only \$15.00. Speedy, durable, handsome. Five-year guarantee. Used by largest corporations. Write today for catalog and free trial offer. Lightning Calculator Co., Dept. O, Grand Rapids, Michigan.

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ADVERTISE in 24 metropolitan dailies, 24 words, \$15.00. Helpful Guide listing 1000 publications, 4c stamps. Wade Company, Baltimore Bldg., Chicago.

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COMBINATION Winner. 125 Magazines, 10c word, \$5.00. Thrice, Interstate Advertiser, Munsing, Mich.

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ADVERTISING in all magazines and newspapers at publishers' lowest rates. Rate book free. Taylor's Advertising Service, Dept. 5, Freeport, Ill.

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PHOTOPLAY—Story ideas wanted. \$25-\$500 paid. Experience unnecessary; outline free to anyone. Write Producers League, 312, St. Louis.

WRITERS—Stories, poems, plays, etc., are wanted for publication. Literary Bureau, 117, Hannibal, Mo.

SONG Poem Writers send for proposition. Ray Hibbler, D10, 4040 Dickens Av., Chicago.

I WANT song poems. Casper Nathan, J-3544 No. Racine, Chicago.

\$\$\$ FOR IDEAS. Photoplay plots considered in any form. Write today for free booklet. Universal Scenario Corporation, 214 Security Bldg., Santa Monica & Western Ave., Hollywood, Calif.

AUTOMOBILES AND ACCESSORIES

DELIVERY bodies for Ford Model T Chassis with enclosed cab, suitable for Contractors, Grocersmen and Farmers. Three styles. Price \$37.50. Write Daniel Zimmerman, Craigville, Indiana.

SCIENTIFIC Gas Saver. All autos. 1 free to introduce. Critchlow, P-120, Wheaton, Ill.

CARBON-X will keep your engine "peppy" by keeping it free from carbon. Handy package and "Why Is Carbon?" postpaid for dollar bill. Money back if you want it. Carbon-X, Box 1953, Chicago.

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LEARN AVIATION! Mechanical. Homestudy. Flying Courses. Earn your way through. Send 25c for catalogue, details. Varney Aircraft Co., Peoria, Ill.

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The American School of Aviation announces a new correspondence course in mechanics of aviation. A thorough training in practical aeronautics. American School of Aviation, Dept. 6741, 3601 Michigan Ave., Chicago, Illinois.

BOYS get a three foot model aeroplane free. Write to Aero Shop, 3050 Huribut Ave., Detroit, Mich.

AERO: Learn Flying by cheapest method. Send one dollar for instructions. Aviator James, P. O. Box 16 A-1, Morris Heights Station, New York.

AVIATION fans: Send one dollar for beautiful pair of Sterling Silver wings mounted on coat lapel pin with safety catch, also identification card issued by National Flyers' Association. Thousands of aviators, aviation mechanics and boosters are wearing these pins. Wallace Aero Company, Bettendorf, Iowa.

AIRPLANES, Motors, Supplies: new 80 H. P. LeRhone Rotary Motor \$125. New 25 H. P. Lawrence \$100; Leather helmets \$3.75; Non-shatterable Goggles: Oval \$2.50; wide-vision \$4. Logan Aircraft, 716 W. Superior, Cleveland.

BOATS AND LAUNCHES

HUBBELL Marine Coolers convert Ford engines into marine motors. Ford dope free to boat owners. C. C. Hubbell, East Ave., Norwalk, Conn.

BLUE PRINTS

TO the man who has a Home Workshop and likes to work with tools, Popular Science Monthly offers the opportunity to purchase blueprints giving details of the construction of useful articles for the home. The following are a few of the blueprints available: No. 1, Sewing Table, No. 5, Kitchen Cabinet, No. 13, Tea Wagon, No. 15, Workshop Bench, No. 17, Cedar and Mahogany Chest, No. 41, One Tube Radio Set, No. 42, Radio Receiver with three stages of amplification, No. 43, Four Tube Radio Receiver. Send 25c for each blueprint that you wish to Popular Science Monthly, 242 Fourth Avenue, New York, N. Y.

Rates 30 Cents a Word. A 10% discount is allowed on all contracts for six consecutive insertions. Advertisements intended for the April, 1926 issue should be received by Feb. 5th

BUSINESS OPPORTUNITIES

BATTERY shop equipment and supplies at wholesale. Adams-Barrs, Columbus, Ohio.

A new mail order book tells exactly how to start, grow and win. Latest methods explained, new ideas and pointers. Free circular tells all about it. MacRea, Publisher, 8058 Oregonian Bldg., Portland, Oregon.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

BUSINESS Guide with free legal service sells everywhere. Wells cleared \$1,185 in 35 days. Write for free outfit. Nichols Co., Naperville, Ill., Dept. 1B.

FREE Book. Start little mail order business. Flor, 976 Cortland Street, N. Y.

\$50 A WEEK. Mail Order business. Booklet tells how. Sample and plan 25c. Outfit furnished you free. Bradford Co., Dept. P, Shawnee, Okla.

USED correspondence school courses. All kinds. Sold on re-purchase basis. Big saving. Money back guarantee. Lists free. (Courses bought.) Lee Mountain, Pisgah, Alabama.

MIRRORS re-silvered at home. Costs less than 5 cents per square foot; you charge 75 cents. Immense profits, platingautoparts, reflectors, tableware, stoves. Refinishing metal ware, etc. Outfits furnished. Write for information. Sprinkle, Plater, 94, Marion, Indiana.

LEARN the collection business. Good income; quick results. Interesting booklet, "Skillful Collecting," free. National Collector's Association, Science Building, Newark, Ohio.

BECOME a Foot Correctionist. A New Profession not medical nor chiropody. All the trade you can attend to; many are making \$3000 to \$10,000 yearly, easy terms for training by mail, no further capital needed or goods to buy, no agency or soliciting. Address Stephenson Laboratory, 10 Back Bay, Boston, Mass.

WE start you in business, furnishing everything: men and women, \$80.00 to \$100.00 weekly operating our "New System Specialty Candy Factories" anywhere. Opportunity lifetime; booklet free. W. Hillyer Ragsdale, Drawer 19, East Orange, N. J.

STOP plodding! Be successful. Operate a tire repair shop. Make big profits in any locality. We teach you and furnish complete equipments, \$100 up. Book of Opportunity free. Haywood's, 1306 South Oakley Avenue, Chicago.

ARE you old at forty? See our advertisement on page 153 of this issue. The Electro Thermal Company, 4054 Main Street, Steubenville, Ohio.

I MADE \$30 a week home. French bread-making, 15 years' experience. Free booklet tells. Ashbrook, E. 67, Marengo, Ohio.

* RESPONSIBLE manufacturer wants competent men to manage office and salesmen. \$300 to \$1500 necessary; will allow expenses to Trenton if you qualify. Address Manager, 536 Forst Richey Bldg., Trenton, N. J.

MANUFACTURE new, fast selling novelties, toys, preparations, mail order, agents' goods. Free list reliable plans, patterns, processes, commercial information. Manufacturers' Bureau, 3937C Tracy, Kansas City, Mo.

A DIFFERENT business worthy, remunerative. Learn privilege trading. Capital \$100 up. Dept. R, Paul Kaye, 149 Broadway, N. Y.

MONEY—Mail order and agency men. The best ever. Exact method we use, particulars 2c. W. P. Stump, Hemet, Calif.

GET OUR FREE LITERATURE on spare time money making enterprises. I. Demuth Co., Englewood, New Jersey.

BUSINESS of your own. Clean rugs. Same method I use. Plan and formula \$1.00. Good for \$10.00 daily. Fink, 1050 Curtis, Toledo, Ohio.

\$50 WEEKLY. Your Own Business Enormous Profits. Plan, Sample 50c. Suydam, P-10748, 112th Street, Richmond Hill, N. Y.

MAKE \$100 to \$300 weekly locally and by mail in a fascinating high class business. Complete instructions sent for 25c. Address U. C. Service, Honesdale, Pa.

START small home Mail Order Business. Booklet 2c. Harvey Teeple, Decatur, Indiana.

SUCCEED With Your Own Products—Make them yourself. Formulas, Processes, Trade-Secrets. Modern master methods. Catalog free. C. Thaxley Co., Washington, D. C.

\$50 WEEKLY. Mail Order Business. Explanatory booklet. Sample and plan 25c. FREE outfit furnished. Whitfield Co., Dept. 8, 2001 West 13th, Oklahoma City, Okla.

MAKE \$15 a day with this amazing Free Reducing Belt. Full time or spare time. No competition. Sells on sight. Big repeats. No experience or capital needed. We furnish everything you need to succeed. Free belt given to sincere workers. Write now for big money-making proposition. The Vito Company, Dept. C52, New Haven, Conn.

BUSINESS SERVICES

CHARTERS—Delaware; best, cheapest; granted day received; free forms. Colonial Charter Co., Wilmington, Del. (99)

MAKE 'Em Pay—My system will make them pay their bills. Write for the acid test. Literature free. Burleigh L. Herr, Horr Omelia Block, Rhinelander, Wis.

CHALK TALKS

LAUGH producing program. \$1.00. Circulars free. Cartoonist Balda, Oshkosh, Wisconsin.

DISTRICT MANAGERS AND REPRESENTATIVES WANTED

WORLD'S fastest selling auto accessory. County distributors wanted; write to-day. G. L. W., Spring Older Co., San Diego, California.

DOGS

BEAUTIFUL registered bull pups cheap. Bulldogs. 501 Rockwood, Dallas, Texas.

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CORRESPONDENCE Courses. All Schools. Lowest prices. Terms. Catalog Free. Mention Subject. Economy Educator, 440-B Sansome, San Francisco.

USED correspondence school courses save over half. Bargain catalogue 1000 courses free. Used courses bought. Students' Exchange, Dept. A, 47 West 42d Street, New York.

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BOOKKEEPING in a week, \$2 complete. Dukes, 640 West 153d Street, New York.

FOR "Free Scholarship" (Mail Course) write Carnegie College, Rogers, Ohio.

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CORRESPONDENCE Courses sold complete: 1-3 usual prices because slightly used; easy terms; money back guarantee. All schools and subjects. Write for special Free catalog. Courses bought for cash. Economy Educator Service, 202-N, West 40th St., New York.

SHORTHAND in four evenings. Arthol course seven dollars. Sent approval. Particulars, Hollefreund's School, Stratford, Ontario, Canada.

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STOP that chugging. Ford runs smoothly at four miles. Starts instantly. "Nonebuck." Installed with wrench. \$1.00. Neutroc Co., Brighton, N. Y.

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SEND One Dollar: For Perfected Liberty Timer for your Ford. Install in two minutes, drive five days at our risk. If after trial you do not consider idling, accelerating and general performance superior to any high priced special ignition system being sold, your money cheerfully refunded. Wallace, Inc. Box 511, Bettendorf, Iowa.

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INVENTOR'S Universal Educator—contains 900 mechanical movements; 50 perpetual motions. Tells how to obtain and sell patents. Suggests new ideas. Explains how to select your attorney and avoid patent sharks. Price (revised edition), \$2.00 postpaid. Albert E. Dietrich, 681 Ouray Bldg., Washington, D. C.

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INVENTIONS Commercialized. Patented or unpatented. Write Adam Fisher Mfg. Co., 183 E. 1st St., St. Louis, Mo.

GET Cash for your patent or invention under our new plan. Write at once to Inventors' Syndicate, 23, Palladium Bldg., St. Louis, Missouri.

PATENTS: My fee in installments. Free personal advice. Frank T. Fuller, Washington, D. C.

GET Your Own Patents. Instructions, legal blanks, \$1. Cooper Cutting, Campbell, Calif.

SELL your patented or unpatented invention. Write for my three plans. Free. Hartley, 44 Central St., Bangor, Maine.

PATENTS wanted by manufacturers; send description. Box 126, Dowagiac, Michigan.

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DETECTIVES—Work home or travel. Experience unnecessary. Write, George Wagner, former Government Detective, 1968P Broadway, N. Y.

BEAUTIFUL handwritten cards, your name. Send quarter for sample dozen to EXPERT PENMAN MEUB, 2365 Mar Vista, Pasadena, Calif.

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FOR Sale: Watchmaker's Lathe at a bargain. R. Jaegermann, 5815 Easton Ave., St. Louis, Mo.

25c BARGAIN—3 beautiful miniature cacti, with illustrated catalogue of Desert plants. C. E. Pattison, 320 Tobin Place, El Paso, Texas.

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O. C. MILLER
 Director
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Be a real

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Prepare
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Before you put your time and money into any kind of training, make sure there are plenty of jobs to be had when you're ready for them. That's why men go into Drafting. 70,000 jobs advertised in 12 months. Big salaries. Fascinating, easy work, short hours, and unlimited opportunities for advancement to executive positions. Drafting isn't one line of work—Draftsmen are needed in nearly all lines—in factories, Architecture, Electricity, and Structural work.



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We have developed a new one-step-at-a-time method which makes Drafting principles easy to understand. Even men with only common schooling make rapid progress with this instruction. Right from the very beginning you do actual Drafting room jobs. And by a wonderful new system you learn without copying, you see why every step is done; so you become a real Draftsman, not a tracer.

Fine, imported instruments like these help you learn Drafting quickly and easily. These standard quality, full size instruments, board, table, triangles, T square, ink, protractor, etc., given without extra charge to every student.

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No building can be erected, no machine constructed, few products can be made until the Draftsman draws the plans. Here's white-collar work for *he-men*! When you see hundreds of men building some big sky-scraper, or bridge, or power plant—you may know that a Draftsman controls everything they do. The Draftsman is the key-man of all industry.

The big money in Drafting goes to men who specialize in Machine Design, or Electrical Drafting, or Architectural Drafting, or Structural, or Automotive. It isn't enough merely to know general Drafting practice. You must know how to calculate and design and plan original work. You need many Engineering subjects, to fill the kind of a Drafting position that pays \$60 to \$125 a week. The American School, for 29 years the leading institution teaching Engineering by home-study, now includes this specialized training in the complete Drafting Course.

Get My Job and Raise Offer!

Look into this opportunity. Get my free book, Job and Raise offer quick! Let me show you how to turn part of your spare time into real training for a real job.

O. C. MILLER, Director Extension Work
 American School, Dept. D-275
 Drexel Ave. & 58th St., Chicago

Please send me Free Drafting Book, Job and Raise offer, and complete information about preparing for a fine Drafting job at home in spare time.

Name.....
 Street No.....
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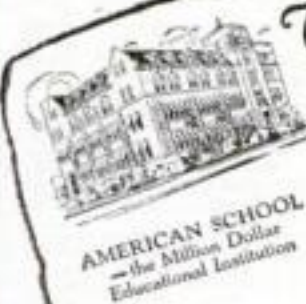
- When you enroll for our home-training in Drafting, we agree to give you:
1. Complete Drafting training, by the new Practice-Method.
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This wonderful, more complete, simplified, up-to-date instruction in Drafting is offered at very low tuition and small monthly payments within the reach of the untrained man who needs it.

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 Director Extension Work
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 Drexel Ave. and 58th St., Chicago



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The AMERICAN SCHOOL now offers its students and graduates, without cost, the services of an efficient Employment Department which keeps in touch with the employers of Draftsmen all over the United States. We have placed hundreds of men in good Drafting positions. We have made this training so complete, so practical, so easy to master, that our students are bound to make good. And, so, because the demand for real Draftsmen continues to exceed the supply, and because this training actually prepares men for good Drafting positions, we back it with a Free Employment Service, free to employers, students, and graduates.

FOR THE HOME

HOT WATER ON TAP, \$6. Make your own Automatie. Write John Kirkeby, San Luis Obispo, Calif.

MEN! WOMEN! MAKE \$1 AN HOUR AT HOME. WEAVING Colonial Rugs, genuine fluff rugs, fancy fabrics, from new and other materials. Home weavers always busy. You learn in 30 minutes. We guarantee it. Looks now as low as \$9.90. Liberal Pay-As-You-Weave terms. Solve YOUR more-money problem by writing for FREE Loom Book today. UNION LOOM WORKS, 482 Factory St., Boonville, N. Y.

GRANDFATHER clock works \$5.00. Build your own case, instructions free; make good profits selling your friends. Clock works with chimes for old or new cases. Write for full particulars. Clock Co., Nicetown, Penn.

TO the man who likes to work with tools, Popular Science Monthly offers the opportunity to purchase blueprints giving details of the construction of useful articles for the home. The following are a few of the blueprints available: No. 1, Sewing Table, No. 5, Kitchen Cabinet, No. 13, Tea Wagon, No. 15, Workshop Bench, No. 17, Cedar and Mahogany Chest, No. 41, One Tube Radio Set, No. 42, Radio Receiver with three stages of amplification, No. 43, Four Tube Radio Receiver. Send 25c for each blueprint that you wish to Popular Science Monthly, 242 Fourth Avenue, New York, N. Y.

HELP WANTED

SILVERING Mirrors, French plate. Ea. learned; immense profits. Plans free. Wear Mirror Works, 31 Excelsior Springs, Mo.

MR. BRUSH Salesmen—Old Established New York Brush Manufacturer requires the services of men in all territories to sell their extensive line of Sanitary Twisted Wire Brushes. We pay larger commissions than any other Brush House in the country. Write immediately for our proposition. Wire Grip Sanitary Brush Corp., 15 Mercer St., New York.

ARE you old at forty? See our advertisement on page 153 of this issue. The Electro Thermal Company, 4054 Main Street, Steubenville, Ohio.

RELIABLE MAN in every town and city to distribute free samples, advertising matter, etc. No selling. Experience unnecessary. Outdoor work. Average pay \$8.00 per day. Write quickly for contract. Supervisor Leary, 5153 North Clark St., Chicago, Ill.

EARN \$10 to \$30 weekly mailing circulars at home. Outfit and instructions, 25c coin. Survival, 4731-2 S. Arlington, Akron, O.

HELP WANTED INSTRUCTION

DETECTIVES Earn Big Money. Excellent opportunity. Travel. Fascinating work. Experience unnecessary. Write George Wagner, former Government Detective, 1968P, Broadway, N. Y.

QUALIFY for \$150—\$300 railroad jobs. Fireman, Brakeman, Baggageman, Sleeping Car or Train Porter, 838 Railway Bureau, East St. Louis, Ill.

GET A U. S. Government Job. Men 18-35. Railway Mail Clerks. Commence \$1900 year. Steady. 25 coached free. Write immediately. Franklin Institute, Dept. M34, Rochester, N. Y.

MEN wanting forest ranger, railway mail clerk and other government positions, write for free particulars of examinations. Mokane, Dept. B-30, Denver, Colo.

HOW TO ENTERTAIN

PLAYS, musical comedies and revues, minstrel music, blackface skits, vaudeville acts, monologs, dialogs, recitations, entertainments, musical readings, stage handbooks, make-up goods. Big catalog free. T. S. Denison & Co., 623 So. Wabash, Dept. 26, Chicago.

INCORPORATIONS

INCORPORATE Delaware. F. Lewis Mettler, 832 Market St., Wilmington, Del. (Established 1909.)

DELAWARE Incorporator, Chartered: Fees Small; forms. Chas. G. Guyer, 901 Orange St., Wilmington, Delaware.

INFORMATION

\$1,000 worth information circular, Free. Lakeside Bureau, 80 Lake, Webster, Mass.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

INSECTS WANTED

WHY not spend Spring, Summer and Fall gathering butterflies, insects? I buy hundreds of kinds for collections. Some worth \$1 to \$7 each. Simple outdoor work with my instructions, pictures, price-list. Send 10 cents (not stamps) for my illustrated Prospectus before sending butterflies. Mr. Sinclair, Dealer in Insects, Dept. 7, Box 1424, Victoria, B. C., Canada.

LABORATORY AND CHEMICAL SERVICES

YOUR chemical problem solved and working process furnished for \$5.00. Write me. W. Stedman Richards, Consulting Chemist, Box 2402, Boston, Mass.

MELT Metals and Alloys. Electric furnaces \$75.00. Speedee-Heat Electric Furnaces, 411 N. Wells St., Chicago, Ill.

FORMULAS: The Best Chemical Science Can devise—Guaranteed Reliable Processes in all lines. Stamp Brings Big Bunch of Valuable Literature, Interesting Lists. Don't buy till you receive this. Chemical Analysts, Charges reasonable. Dr. Liscomb Miller, Chemist, Tampa, Florida.

LANGUAGES

WORLD-ROMIC System, Masterkey 5,000 languages. Primers \$1.98. Chinese, French, Spanish—Languages, 8 West 40th, New York.

LETTER SPECIALISTS

I WRITE letters, folders, booklets, complete followup for manufacturers, mail order dealers. Long experience. Write for details. L. Taylor, Box 844, Freeport, Ill.

LISTS

NAMES, addressing, cuts. Ben Meyer, 35 West 31st St., New York.

MAGIC TRICKS

BE a magician, give shows, earn money. Catalogue 20 cents. Oaks Magical Co., Dept. 550, Oshkosh, Wis.

BOOKS, Magic, Mysteries, Magic Tricks, Novelties. Catalogue Free. Singer 515, Hancock, Wisconsin.

MAIL ORDER BUSINESS

\$3000 extra a year, home evenings, I made it. Mail Order Business. Advertising Booklet for stamp explains. Sample and plan 25c. Alps Scott, Cohoes, N. Y.

\$50 A WEEK. Mail Order business. Booklet tells how. Sample and plan 25c. Outfit furnished you Free. Bradford Co., Dept. P, Shawnee, Okla.

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MANUFACTURING

DEVELOPING Ideas and manufacturing our specialty. Absolute satisfaction. 33 years' experience; write us. The K. & B. Die & Specialty Co., 2018 Elm St., Cincinnati, Ohio, Dept. C.

ADVICE from engineers will save you from making costly mistakes in buying radio and tool equipment. Write to Popular Science Institute, 246 Fourth Ave., New York City, for list of tested and approved products. See page 6.

WANTED light manufacturing and experimental work. Prices guaranteed to be cheapest in America. Send models or drawings for quotations. Mele's Mfg. Co. Station A, New Haven, Conn.

MISCELLANEOUS

FORMS to cast Lead Soldiers, Indians, Marines, Trappers, Animals, 151 kinds. Send 10c for Illustrated Catalogue. Henry C. Schiereke, 1034 72nd St., Brooklyn, N. Y.

WANTED—Representatives in every factory in the United States. Popular Science Monthly, 250 Fourth Ave., New York.

MINERAL Treasure under foot! Find it! Cash it! Information 10c. Minerals identified \$1.00. Mineral specimens. Buskin, Geologist, Joplin, Mo.

MODELS AND MODEL SUPPLIES

WE make working models for inventors and experimental work, and carry a complete stock of brass gears and model supplies. Send for catalogue. The Pierce Model Works, Tinney Park, Illinois.

WE Build Models, design, develop and manufacture articles in large or small quantities. Hohmeier Mfg. Co., 1385 E. 17th St., Cleveland, O.

MOTORCYCLES, BICYCLES, SUPPLIES

OVERSTOCKED Used Motorcycles, 1923 Indian Chief, \$95.00, 1923 Harley Davidson, \$95.00, 1923 Henderson Deluxe, \$120.00. Two hundred others, write for free list. Myerow Brothers Co., 14 Berkeley St., Boston, Mass.

DON'T buy a bicycle motor attachment until you get our catalogue and prices. Shaw Mfg. Co., Dept. 4, Galesburg, Kansas.

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MOTORS, ENGINES AND MACHINERY

GUARANTEED: 1/2 HP., 110-volt, 60 cycle, single phase, used motors with pulley, at \$7.50 each. Also brand new 1/2 HP., 110-volt, Westinghouse make at \$13.75 each. Brand new 1 KW Westinghouse, 32-volt, 1150 speed, light and power generators at \$48.00 each. 25% cash, balance C. O. D. We have special prices on 32-volt motors. We repair and rewind electric motors and generators, etc. Bargains on electric fans. General Distributing Co., Security Storage Bldg., Duluth, Minn.

MOTORS: Curtiss OXX-6 Class A (under Fifty Hours) for Plane, Sea-Sled, Motor boat, etc., \$175.00. All Motor and Plane Spares at Best Prices. Send for Catalogue. Monumental Aircraft Co., 339 N. St. Paul Terrace, Baltimore, Md.

MUSICAL

SAXOPHONISTS—Clarinetists—Cornetists—Trombonists—get "Free Pointers." Virtuoso Music School, Buffalo, N. Y.

OFFICE DEVICES

ADDRESSING machines, multigraph, duplicators, folders, check writers, sealers, dictating machines, at about half new cost. Pruitt, 117 N. Market St., Chicago.

OPTICAL GOODS

ARTIFICIAL eyes. Booklet free. Denver Optic, 508 Barclay, Denver, Colorado.

PATENT ATTORNEYS

PATENTS—Time counts in applying for patents. Don't risk delay in protecting your ideas. Send sketch or model for instructions or write for FREE book, "How to Obtain a Patent" and "Record of Invention" form. No charge for information on how to proceed. Communications strictly confidential. Prompt, careful, efficient service. Clarence A. O'Brien, Registered Patent Attorney, 184-K Security Bank Building (directly across street from Patent Office), Washington, D. C. (See page 141)

PATENTS—Before disclosing an invention the inventor should write for our blank form "Record of Invention." This should be signed, witnessed and returned to us together with model or sketch and description of the invention for Free Inspection and Instructions. Our Three Books mailed free to inventors. Our Illustrated Guide Book, "How to Obtain a Patent," contains full instructions regarding patents. Copies of unsolicited letters from manufacturers and others who are constantly writing us regarding the purchase or leasing of meritorious patents sent upon request. See advertisement on page 143. Victor J. Evans & Co., 937 Ninth, Washington, D. C.

"INVENTOR'S ADVISER," the valuable Patent book with 139 mechanical movements and illustrations, sent free upon request—M. S. Labiner, Patent Attorney, 3 Park Row, New York.

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UNPATENTED Ideas Can Be Sold. I tell you how and help you make the sale. Free particulars (Copyrighted 1923). Write W. T. Greene, 811 Jenner Building, Washington, D. C.

MILLIONS spent annually for ideas! Hundreds now wanted! Patent yours and profit! Write today for free book—tells how to protect yourself, how to invent, ideas wanted! how we help you sell, etc. American Industries, Inc., 501 Kresge Bldg., Washington, D. C.

PATENTS, Trade-Marks, all countries. Ten years' experience examining applications in Patent Office. Consultation invited. George Beeler, Patent Attorney, 150 Nassau Street, New York.

ESTABLISHED 1864. Milo E. Stevens Company, Free Booklet, Patents, Trade-Marks, Copyrights. Offices, Monadnock Block, Chicago; Barrister Building, Washington, D. C.

PATENTS: My fee in installments. Free personal advice. Frank T. Fuller, Washington, D. C.

MONROE E. MILLER, Ouray Bldg., Washington, D. C., Patent Lawyer, Mechanical, Electrical Expert. Booklet and Priority Record blank gratis.

PATENTS—Send for form "Evidence of Conception" to be signed and witnessed. Form, fee schedule, information free. Lancaster and Allwine, Registered Patent Attorneys in United States and Canada, 232 Ouray Bldg., Washington, D. C.

PATENTS Procured: Trade Marks Registered.—A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 44 Owen Bldg., Washington, D. C., or 41-Z Park Row, New York.

PROTECTIVE PATENTS at Fair Prices. Drawings, specification, claims, \$20. Send description with half fee. Prompt, efficient service. American Patents Corporation, Barrister Building, Washington, D. C.

RICHARD E. BABCOCK, Patent Lawyer, Washington Loan & Trust Bldg., Washington, D. C. Established 1877. Booklet.

INVENTORS—who derive largest profits know and heed certain simple but vital facts before applying for patents. Our book, Patent-Sense, gives those facts free. Write Lacey & Lacey, 648 F. St., Washington, D. C. Established 1869.

PHOTOGRAPHY AND SUPPLIES

HAVE you a camera? Write for free sample of our big magazine, showing how to make better pictures and earn money. American Photography, 117 Camera House, Boston, 17, Massachusetts.

ESTABLISH yourself at home, as a photographic expert; make \$75 a week while learning; professional camera furnished free; write quick for full information. International Studios, Dept. 1743, 3601 Michigan Ave., Chicago.

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PHOTOGRAPHS made from sketches or ideas. Photos for artists. Strucketts, 749 Dundas, London, Ont.

UNEXCELLED Gloss Prints. Trial Offer. Your Kodak Film Developed and Printed only 10c. F. R. B. Photographers, Dept. "G," 1503 Lincoln Ave., Cincinnati, Ohio.

PRINTING AND ENGRAVING

\$3.00 DELIVERED. 500 Watermarked Bond Letterheads, 8 1/2 x 11, and 250 envelopes, money with order. Job Printing Specialty. National Printing Company, Dept. S, Goshen, Ind.

1,000 Letterheads, Envelopes, Cards, \$3.00 postpaid; 500, \$2.25. Samples Free. Artservis Press, 66 Houghton, Worcester, Mass.

HIGH Grade Printing—5,000 20-lb. Hamamori Bond Letter Heads, \$13.75; 10,000, \$24.00. 6 3/4 white wave envelopes, one thousand, \$2.25. The Courier Company, Zanesville, Ohio.

MONEY making business forms sent free. Cornish, Schenectady, N. Y.

200 Business Envelopes \$1.00. Commercial size, for business use. Name, business and address. Prompt service. List of 10 Big Dollar Specials Free. P. S. Kendall, Elmira, N. Y.

BETTER Printing for Less Money. Write us about your printing needs, and you will save money. Ernest Fantus Company, 525 South Dearborn Street, Chicago.

500 LETTERHEADS and Envelopes, \$5.00. Other printing cheap. Williams, 83, Aurora, Ind.

"NEARGRAVURE" Process—1000 Business Cards, \$1.50. Postpaid. Solidays, Knox, Indiana.

PRINT your own cards, stationery, circulars, paper, etc. Complete outfits \$8.85; Job Presses \$12, \$35; Rotary \$150. Print for others, big profit. All easy rules sent. Write for catalogue presses, type, paper, etc. Press Company, A-3, Meriden, Conn.

EVERYTHING Printed. Samples for stamps. Franklin Press, B-34, Milford, New Hampshire.

RADIO

JOIN Radio University, Free. This department in RADIO WORLD, first illustrated weekly, solves your radio troubles. See current issue and join free. Many booklets; other great features. 15c copy. Newsdealers. Special: 50c for trial subscription 4 issues; or \$1 nine issues. Radio World, 145 W. 46th St., N. Y.

RAZORS AND BLADES

1,000 SHAVES from one razor blade. Secret 25c. Barber, Box 1278, San Francisco.

REAL ESTATE—ORCHARDS

PECAN—Orange—Fig Groves. "On the Gulf" guaranteed care. Monthly payments. Big quick returns. Suburban Orchards, Dept. S, Biloxi, Miss.

Don't Pay Me a Cent If I Can't Give You a *Magnetic Personality* -5 Days FREE Proof!

NO matter how lacking you are in qualities of leadership, no matter how colorless, timid, unsuccessful and discouraged you may be, I GUARANTEE to so magnetize your personality that your whole life will be completely transformed!

I can give you poise that banishes self-consciousness, charm that makes you irresistibly popular, personal power that will indelibly influence the minds of others and amaze your friends.

I'll make you a fascinating force in social life, a powerful, dynamic, commanding figure in your profession. You'll become more popular, more prosperous, more gloriously successful than you ever dreamed possible!

Let me send you the proof—absolutely free! If within 5 days you do not experience a decided change in your personality, if you do not find yourself making new friends with ease, if you do not discover yourself already on the way to social popularity, business success and personal leadership—just say so. Tell me my principle of personal magnetism can't do every single thing that I said it would do. And you won't owe me one penny!

What is Personal Magnetism

What is this marvelous force that raises the sick to glowing, vibrant health, the timid to a new confident personality, the unsuccessful to positions of wealth and astonishing power?

You have it—everyone has it—but not one person in a thousand knows how to use it! It is not a fad, nor a theory. It is simply you, yourself—your manner—your own marvelous

personal force, released and magnified a hundred fold in an amazingly clear-as-crystal, scientific way! More necessary than good looks. More valuable than money. For without it a salesman is handcuffed! Without it a business man is powerless to command! No actor, no teacher, no

orator, no statesman can long hold his audience spellbound without this supremely influential magnetic force!

Personal Magnetism! How easy to release it! How wonderful its results! No long study or inconvenience. Not the slightest self-denial. Just a simple, clear, age-old principle that taps the vast thought and power resources within you, releases the full sweep of your magnetic potentialities and makes you almost a new person from what you were before!

Personal Magnetism is not hypnotism. Hypnotism deadens. Magnetism awakens, inspires, uplifts. Personal Magnetism is not electricity. It is like electricity in one way—while you cannot see it, you can observe its startling effects. For the moment you release your Personal Magnetism you feel a new surge of power within you. You lose all fear. You gain complete self-confidence. You become almost over night the confident, dominant, successful personality you were intended to be—so fascinating that people are drawn to you as irresistibly as steel is drawn to a magnet!

The Facts Are Free

The fundamental principles of Personal Magnetism have been put into an extra large volume under the title of "The Cultivation of Personal Magnetism." It is bound in beautiful dark burgundy, with the title



gold embossed. Its scope is as broad as life itself. "Fires of Magnetism," "Sex Influences," "The Magnetic Voice," "Physical Magnetism," "The Magnetic Eye," "The Road to Power" and "The Winning Personality" are only a few of the subjects covered in this amazing book. A magnificent book that tells you just how to cultivate the magnetic influence of your nature.

You can sway and control others. You can command success. You can influence people to do the things you want them to do. Through this amazing book you gain the key to a magnetic personality in 5 days—or you don't pay one penny. That is my free offer to you!

Send Coupon Today

You must see this wonderful volume—examine it—let it influence indelibly your own personality. You send no money with the coupon—you pay no C. O. D. You get the book first. If you aren't stirred and delighted in the 5 days' period, return it and it costs you nothing. Otherwise keep it as your own and remit \$3 in full payment. You are the sole judge. You do not pay unless you are absolutely delighted. And then only \$3.

You simply can't delay. Clip and mail the coupon. NOW.

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Dept. 14B

RALSTON UNIVERSITY PRESS,
Dept. 14B, Meriden, Conn.

All right—I'll be the judge. You may send me the volume "Cultivation of Personal Magnetism" for 5 days FREE EXAMINATION in my home. Within the 5 days I will either remit the special low price of only \$3.00 or return the book without cost or obligation.

Name.....

Address.....

City.....State.....

What Others Say!

"Has been worth ten thousand dollars a year."

"I am indebted to Shaftesbury for all that I am in this world."

"All I have I owe to my daily habit of studying Shaftesbury."

"I am glad that I dared to buy the books."

"The Personal Magnetism books have raised me from poverty to my present position."

"There is nothing better."

"I would not part with them for any sum of money."

"One of the greatest books I have ever seen—the greatest in existence."

"Made me a success—financially, socially and morally."

"I would not give up what Shaftesbury has taught me for \$100,000."

SALESMEN AND AGENTS WANTED

AGENTS—Make a dollar an hour. Sell Mendets, a patent patch for instantly mending leaks in all utensils. Sample package free. Collette Mfg. Co., Dept. 467, Amsterdam, N. Y.

EARN \$10 daily silvering mirrors, plating and refinishing metal ware, headlights, chandeliers, bedsteads. Outfits furnished. F. Decie Laboratories, 1133 Broadway, New York.

AGENTS—Write for free samples. Sell Madison "Better-Made" Shirts for large Manufacturer direct to wearer. No capital or experience required. Many earn \$100 weekly and bonus. Madison Co., 566 Broadway, New York.

WE start you without a dollar. Soaps, extracts, perfumes, toilet goods. Experience unnecessary. Carnation Co., Dept. 21, St. Louis.

AGENTS—Clever invention! Inkspoon makes every pen a fountain pen. Past office seller, big profit, demand increasing everywhere. Exclusive territory offered. Sample free. H. Marul Company, Tribune Building, New York.

INSTANT Weld—Repairs large punctures without cement or heat. Lenn's profit one day \$56. Write quick. Free sample. Territory going fast. Tourist's Pride Mfg. Co., Desk R, Minneapolis, Minnesota.

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GET our free sample case toilet articles, perfumes and specialties. Wonderfully profitable. La Derma Co., Dept. F., St. Louis, Missouri.

AGENTS: Sell \$23.50 suits, overcoats, all wool, one price. Wonderful values, liberal commissions in advance, money back guarantee, 9 x 13 swatch outfit free. Write M. W. Harvey, Mgr., Box 90, Chicago.

WASH Clothes the new way. Use the Torrent Automatic Washer. You will be delighted. Special offer to one in each locality. Storm Royalty Co., 3614 Enright Ave., St. Louis, Mo.

300% PROFIT Selling Mitchell's Magic Marvel Washing Compound. Men and women clearing hundreds weekly. Wonderful seller. Big repeater. Nature's mightiest cleanser. Free sample. L. Mitchell, Drawer 1308, E. 61st Street, Chicago.

AGENTS. \$60—\$200 a week. Genuine gold letters for store windows easily applied. Free samples. Liberal offer to general agents. Metallic Letter Co., 434-A, N. Clark, Chicago.

GET our plan for monogramming automobiles, trucks, hand luggage and all similar articles by transfer method. Experience unnecessary; exceptional profits. Motorists' Accessories Company, Mansfield, Ohio.

POLMET POLISHING CLOTH cleans all metals. Sells fast at 25c. Sample free. F. C. Gale, 15 Edinboro St., Boston.

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SELF-THREADING Needles find sales in every home. Fine side line; easily carried; big profits; sample free. Lea Brothers, 147 East 23rd St., New York.

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TAKE orders for coffee, sugar, flour, meats, canned goods, staple groceries, also paints, radio sets, tires, auto and tractor oils. No capital or bond required. We deliver and collect. Permanent business. Big pay. Write at once. Hitchcock-Hill Co., Dept. 81, Chicago.

BANKRUPT and Rummage Sales. Make \$50.00 daily. We start you, furnishing everything. Distributors Dept. 34, 609 Division, Chicago.

AGENTS—Steady income. Large manufacturer of handkerchiefs and dress goods, etc., wishes representative in each locality. Factory to consumer. Big profits, honest goods. Credit given. Send for particulars. Freepart Mfg. Co., 24 Main St., Brooklyn, N. Y.

\$10 DAILY silvering mirrors, plating and refinishing lamps, reflectors, autos, beds, chandeliers by new method. Outfits furnished. Write Gunmetal Co., Ave. F, Deatur, Illinois.

AGENTS—Best seller; Jem Rubber Repair for tires and tubes; supersedes vulcanization at a saving of over 800 per cent; put it on cold, it vulcanizes itself in two minutes, and is guaranteed to last the life of the tire or tube; sells to every auto owner and accessory dealer. For particulars how to make big money and free sample, address Amazon Rubber Co., 504 Amazon Building, Philadelphia, Pennsylvania.

SELLS for \$9.75. Prints ad on wrapping paper, envelopes, etc. \$4.00 commission. Send 10c for sample work. Automatic Ad-Stamp, Joplin, Mo.

LIGHTNING Electrolyte. Charges storage batteries instantly. Guaranteed not to injure battery. Gallon costs 50c sells \$10.00. Chance to clean up fortune selling to garages and agents. Make it yourself. Guaranteed formula \$5.00. Write for free circulars. Murphy, Chemist, Tujunga, Calif., Box-K.

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AGENTS. New Selling Plan! \$1.25 premium free to every customer on a \$2.00 sale, consisting of 8-oz. Vanilla, 6-oz. Shampoo, 4-oz. Lemon Lotion. A big hit everywhere. Complete details free. Territory going fast. Write today. The C. I. Togstad Company, Dept. 10-B, 29 South Clinton St., Chicago, Ill.

FREE Booklet describes 52 plans for making \$20.00 to \$100.00 weekly in home or office business of your own. Downs Co., 2326 Myrtle, St. Paul, Minn.

A BUSINESS of your own. Make and sell chipped glass name and house number plates, checkerboards, signs. Booklet FREE, E. Palmer, Dept. 513, Wooster, Ohio.

SALESMEN AND AGENTS WANTED

NO dull times selling food. People must eat. Federal distributors make big money; \$3,000 yearly and up. No capital or experience needed; guaranteed sales; unsold goods may be returned. We furnish you with license. Your \$20.00 starting order sent on trust. **FREE SAMPLES** to customers. Repeat orders sure; Exclusive territory. Ask now! Federal Pure Food Co., L-2311 Archer, Chicago.

AN UNUSUAL opportunity—Earn \$75.00 weekly and bonus taking orders for Nustile guaranteed Hosiery. Sample outfit furnished. Full or spare time. Write now. The Nustile Company, Dept. 4-12, Philadelphia, Pa.

AUTOMOTIVE specialty salesmen. Year round steady profits. Adams-Barrs, Columbus, Ohio.

AGENTS WANTED TO ADVERTISE OUR goods and distribute samples given to consumers; 90c an hour; write for full particulars. American Products Co., 5787 American Bldg., Cincinnati, Ohio.

LIGHTNING storage battery compound. Charges discharged batteries instantly. Eliminates old method entirely. Gallon free to agents. Lightning Co., St. Paul, Minn.

\$50 DAILY Selling Salesboards—Make up to \$33 on single sale selling largest, lowest priced line; no samples to carry, write for 3-color catalogue and full particulars. Lincoln Sales Co., Dept. K, 9 S. Clinton, Chicago.

AGENTS sell Alward's Egyptian Dream Incense for quick sales and big profits. Send for wholesale price list with free sample. Telchert Incense Co., 2402 Bronson Ave., Los Angeles, Calif.

MIRRORS re-silvered at home. Costs less. 5 cents per square foot; you charge 75 cents. Immense profits, plating auto parts, reflectors, tableware, stoves. Refinishing metalware, etc. Outfits furnished. Write for information. Sprinkle, Plater 96, Marion, Indiana.

FREE: A beautiful 5 tube tuned radio frequency receiver, to the first man in each community who answers this ad within 10 days. Write now for particulars. A nationally advertised loud speaker will be sent free every Monday morning for the first letter opened. E. Parker, Putnam St., Peabody, Mass.

EARN \$18 daily selling new automobile product. Experience unnecessary. Free folder explains; get it today. Boone Specialty Co., Dept.-Auto, Boone, Iowa.

REPLATE brass worn-off automobile parts. Reflectors. Bathroom fixtures, worn spoons, forks, etc., with pure silver. Look like new. Use U-Kan-Plate Polish. Positively no mercury. \$1.00 half pint. Postpaid. Satisfaction guaranteed. Agents wanted. U-Kan-Plate Co., Dept. B, Philadelphia.

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SUCCEED With Your Own Products—Make them yourself. Formulas, Processes, Trade-Secrets. Modern master methods. Catalog free. C. Thaxly Co., Washington, D. C.

OVER 110% profit, self-lighting gas and cigar lighters: Everybody interested; repeat business. Sell individuals, dealers, subagents. Particulars free. S. M. Bernhardt, 148 Chambers St., New York.

SELL "Everyday Greeting Cards." Boxed. 35% commission. Soliciting folder, 10c. Wolfprint, Lawndale, Philadelphia.

BUILD splendid business making chipped glass number and name plates. Particulars free. Simplex Co., Dept. 83, 1133 Broadway, New York.

\$20 DAILY selling VER-I-EZY Men's shoes direct. Sell relatives, friends, neighbors first. Low priced. Give real comfort, long service. You take orders, keep big commission. We ship and collect. Full or part time. Write NOW. Easy-wear Shoe Company, Dept. 233, Indianapolis, Ind.

44 MILES on 1 Gallon—Scientific Gas Saver. All autos. 1 free to introduce. Critchlow, M-120, Wheaton, Ill.

MANUFACTURER World's Greatest Envelope Sealer. Seals 2000 envelopes hour. Retail, \$4.50. Tremendous market, big repeats. Write quick exclusive territory. Ford, 3351 Nottingham Bldg., Boston, Mass.

SALESMEN: Write your name and address on a card and mail to us. We'll show you sure earnings of \$20.00 a day. Will you risk one minute and a one-cent stamp against \$20.00? Mind you, we say we'll show you. Address Sales Manager, 850 W. Adams St., Dept. 744, Chicago, Ill.

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AGENTS WANTED—Something new—Fyr-Fyter sells easily. Makes a spectacular demonstration; car owners, homes, factories, stores, practically buy on sight. Our men make \$10 to \$50 a day. Exclusive territory to producers. If you wish to establish a business of your own with unlimited possibilities for making big money, write us today. Fyr-Fyter Co., 999 Fyr-Fyter Bldg., Dayton, Ohio.

AGENTS—\$75 to \$150 Weekly to introduce "Chief-tain" 3 for \$4.95 Guaranteed Tailored Shirts. Samples and full working outfit free. **YOUR PAY DAILY.** Cincinnati Shirt Company, Secy. 1602, Cincinnati, Ohio.

AGENTS—Men, women, full or part time; no experience necessary; \$15 a day easy made; particulars free. Medallion Novelty Co., Box 295, Haverhill, Mass.

ONE CENT! POST CARD FROM YOU brings free solid gold stud offer to Agents. Rajah Rainbow Gem Deceives experts. Dept. F-10 Rainbow Gem Co., Salisbury, N. C.

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DUSTLESS Sponge Cloth. New invention. (1) Rub—Dusts, Cleans and Polishes Automobiles, Furniture, Pianos. Retail 50c.—Costs 16c. Sample Free. Nu Life Sponge, Hartford, Conn.

I'LL PAY you \$160 month taking orders for Jennings Guaranteed Hosiery. New plan puts you above competition. Write quick for amazing offer. Jennings Co., Dept. 232, Dayton, Ohio.

SALESMEN AND AGENTS WANTED

WONDERFUL INVENTION! Eliminates phonograph needles. Preserves records. Abolishes scratching. 14,000,000 prospects. \$20 daily. Supply in pocket. Sample on approval if requested. Everplay, Desk, G-2, McClurg Bldg., Chicago.

NEWEST INVENTION! Sells every office, home, store. Automatically coils telephone and iron cords. Abolishes snarls and kinks. Great time and temper saver. \$25 daily. Samples for test if desired. Never-knot, Dept. 2-9, McClurg Bldg., Chicago.

AGENTS: \$11.80 daily pay (send for sworn proof) introducing New Insured Hosiery. 57 styles, 40 colors, guaranteed seven months. No capital or experience required. You simply take orders. We deliver and collect (or you can deliver, suit yourself). Credit given. **PAY YOU DAILY,** monthly bonus besides. Early spring line now ready. We furnish samples. Spare time will do. Macoshee Textile Company, Card 1522, Cincinnati, Ohio.

WORLD'S Largest Neckwear Manufacturer wants Agents. Remarkable opportunity. Immediate commissions 32½%. Advance Styles, complete line. Greatest values. Beacon, 1524 Beaconwear Bldg., Boston, Mass.

GET INTO BUSINESS FOR YOURSELF

Make storekeeper's profits without storekeeper's troubles. We'll show you how. In fact, we'll put you into business, furnish everything you need, train you, carry stock for you without your investing a penny. We'll work with you until we've made you a success. We have done it for others. We'll do it for you—provided you are honest, ambitious and willing to work hard. If you are, write us. You'll hear from us at once with FACTS. Address Dept. 143, GOODWEAR Chicago, Inc., 844 West Adams St., Chicago.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

FREE sample—"Rain Shield Wiper," retails \$1.00—cost 25c. Just invented. No cloth—no paste—no attachment. Sold clear and rainy days—(1) rub keeps windshield clear 24 hours. Automobiles buy quickly. Riley made \$198.00 three days. Experience unnecessary. Wonderful sideline. NuLife Corporation, Hartford, Conn.

AGENTS make \$100 week placing advertising Cigar Lighters with glass front. Every dealer wants one. Write for free plan. Drake Mfg. Co., Dept. F, Milwaukee, Wis.

\$20 PROFIT daily selling needlebooks; costs 3-5c each; sells 25c, value 50c. Three samples 25c. Catalogue free. Needlebook Specialty Co., 661 Broadway, New York.

SELL fine made-to-order all wool suits at \$31.50. Regular \$55 values. Over 100 6 x 9 cloth samples, all one price. Furnished. Hustlers earn \$100 Weekly. Write W. Z. Gibson, Inc., 161 W. Harrison St., Dept. P-626, Chicago, Ill.

DISTRICT salesman for union made, hand tailored, all wool suits and overcoats at \$23.50. Prefer married man with sales experience. \$35 weekly to start. Apply N. A. Harvey, Mgr., Box 90, Chicago.

SELL BY MAIL! Big Profits! Books, Formulas, Novelties, Bargains. Particulars Free! Elfco, 523 South Dearborn Street, Chicago.

MAKE \$100 weekly in spare time. Sell what the public wants—long distance radio receiving sets. Two sales weekly pays \$100 profit. No big investment, no canvassing. Sharpe of Colorado made \$965 in one month. Representatives wanted at once. This plan is sweeping the country—write today before your county is gone. Ozarka, Inc., 126 C. Austin Ave., Chicago.

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WE pay \$200 Monthly Salary, furnish car and expenses to introduce our guaranteed poultry and stock powders, cleaner, etc. Bigler Company, X371, Springfield, Illinois.

OUR men find sales easy. Patented shirt turns inside out. Lasts twice as long. Sells on sight. Customers tell friends. Big money. Write Walton Duplex, Dept. B23, Brooks Bldg., Chicago.

49c PROFIT Every 50c sale; wonderful proposition; \$6.00 worth Free; **HARDY**, Freeman Building, Atlantic City, New Jersey.

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TEN Million Customers eager for new 50c household necessity. Cash in big with exclusive virgin territory. Write today. Manufacturers Consolidated Co., Dept. 101, Grand Rapids, Mich.

ADVICE from engineers will save you from making costly mistakes in buying radio and tool equipment. Write to Popular Science Institute, 246 Fourth Ave., New York City, for list of tested and approved products. See page 6.

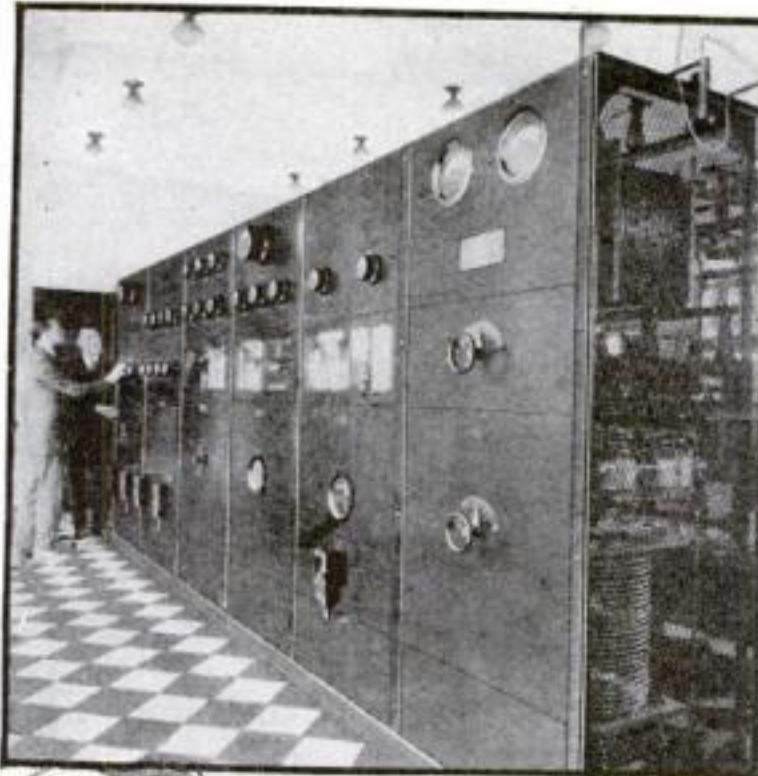
BIG money and fast sales. Every owner buys gold initials for his auto. You charge \$1.50; make \$1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 47, East Orange, New Jersey.

AGENTS, both sexes, we manufacture and control new household article. Fast seller. Big profits. Exclusive territory. Write now. Connolly, 123 Liberty St., New York.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know wouldn't you? Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

ARE you old at forty? See our advertisement on page 153 of this issue. The Electro Thermal Company, 4054 Main, Steubenville, Ohio.

\$31.00 PROFIT—With \$1.50 Outfit. Big money—easy work. Selling gold monograms for automobiles, luggage, windows, wagons. No Experience. No license. "Sample free." NuLife Monograms, Hartford, Conn.



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WANTED—Representatives in every factory in the United States. Popular Science Monthly, 250 Fourth Ave., New York.

\$100 in Cash Prizes

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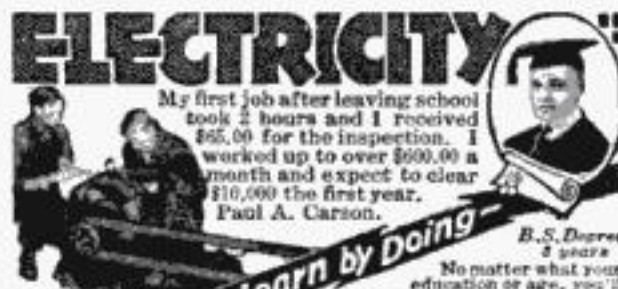
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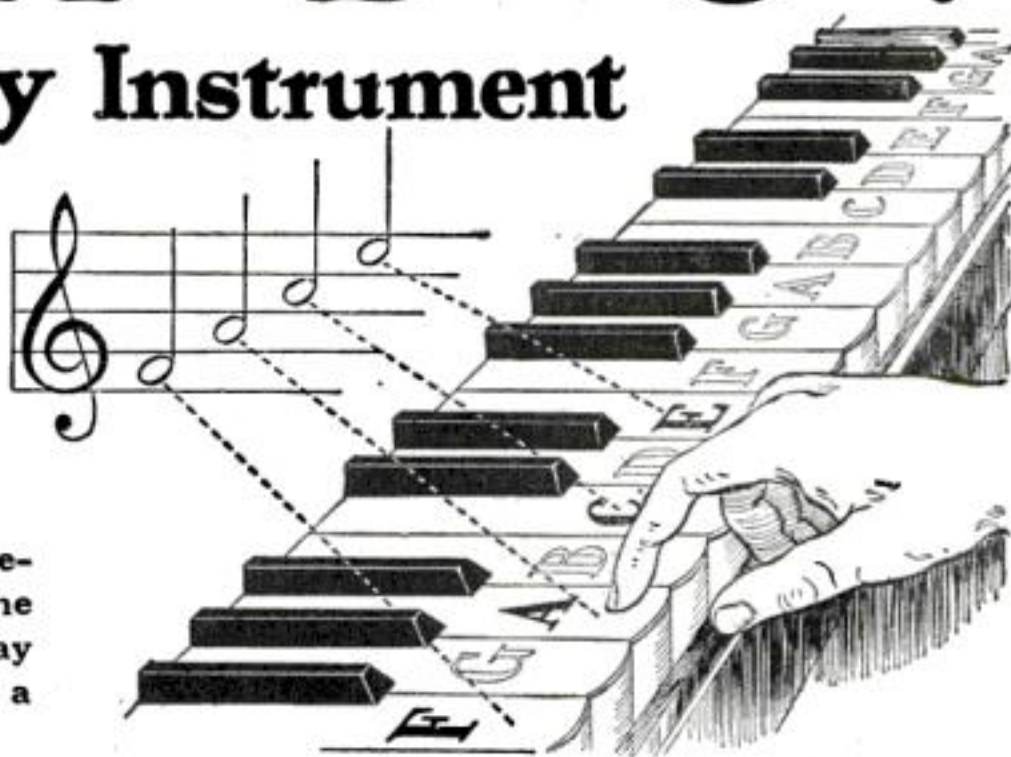
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Yes, the new way teaches you to play from *notes*, just like the best musicians do. There are no trick "numbers," no "memory stunts." When you finish the U. S. School of Music course, you can pick up any piece of

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Please write name and address plainly so that there will be no difficulty in booklet reaching you

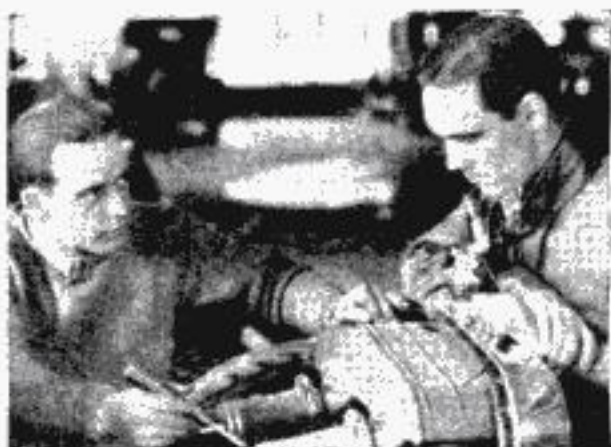
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Recent Publications

Clockmaking Past and Present, by G. F. C. Gordon. A handbook for clock-makers, repairers, dealers, and collectors, describing parts of clocks, how clocks are put together and repaired. Illustrated. Norman W. Henley Publishing Company.

Construction Drawing, by Joseph Brady and Samuel Landsman. A clear and simple book for beginners in architectural drawing. Designed to prepare students of vocational and trades school classes for work of average architect's office. Illustrated. D. Van Nostrand Company.

Science as Revelation, by John M. Watson. How the discoveries of the many branches of science lead to a new conception of God and a new religion. The Macmillan Company.

Sins of Science, by Scudder Klyce. Evidence compiled to urge that evolution theories advanced by scientists are wrong. Marshall Jones Company.

Automobile and Gasoline Engine Encyclopedia, by A. L. Dyke. A new edition of a valued reference book on automobiles. New additions are unique trouble-shooting charts in colors listing possible troubles and giving the effect, test, and remedy for each. New Ford electrical diagrams. Descriptions of ignition systems and construction and repair information brought up to date. Illustrated. Goodheart, Willcox Co., Inc.

A Bullet-Proof Airplane Tank

AN AIRPLANE gasoline tank which, it is claimed, may be riddled completely by incendiary or explosive bullets without bursting into flames or even leaking, is the latest development in aviation. It comes from Vienna. The tank is the usual metal type, but with a peculiar interior coating, the composition of which is a carefully guarded secret with the inventor, probably on the order of the liquid gums placed in automobile tires to make them puncture proof. There is also, according to the claims of the patentee, a special mechanism inside the tank that eliminates all the effects of explosion either of bullets or of gas fumes.

The inflammatory bullet, upon entering the tank, is immediately enveloped with a coating of some sort of material that extinguishes the flame, and at the same time prevents a phosphorus-coated bullet from leaving a deposit.

In a test made by expert army witnesses, a series of 20 bullets was fired through the experimental tank, which was filled half with gasoline and half with inflammable gas. The bullets were fired in a series of one explosive, one phosphorous, and one solid, in rotation. After the 20 rounds had been fired with no bad results, the tank was set in an airplane, which then made an hour's flight, using only the gasoline from the apparently perforated tank. No leak or fire occurred, and no other trouble of any kind.

The invention is arousing great interest in the U. S. War Department, as the figures of the World War taken from the German War Office show that 80 per cent of the planes brought down in flames were fired either by phosphorous bullets, or caught fire from tank leaks.



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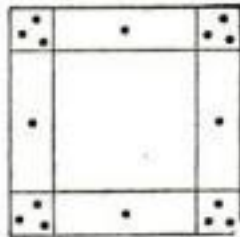
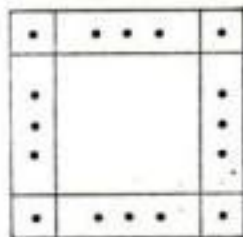
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Solution to Tests on Pages 13 and 14



1. Ingenuity Test.

The average person can complete this test in three minutes.

2. Cancellation Test.

If your mind works with average speed, you should have crossed out all the 0's in two minutes.

3. Word-Building Test.

A person of average intelligence can make 22 words of the six letters in five minutes. If you have made more than this, it indicates that your power of imagination is exceptionally well developed.

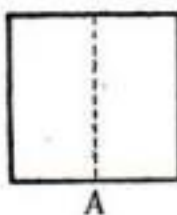
4. Coin Test.

If you have completed this test in 10 minutes or less, you are of better than average mathematical ability.

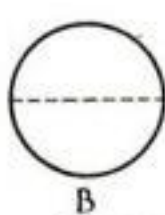
5. Geometrical Test.

The final score in this test is obtained by counting the number of figures in which lines are drawn as shown in this diagram. The following will enable you to obtain your rating:

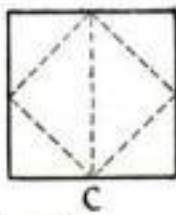
- 0 to 1—Inferior ability.
- 2 to 3—Below average ability.
- 3 to 4—Average ability.
- 5 to 6—Superior ability.



A



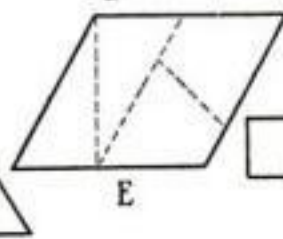
B



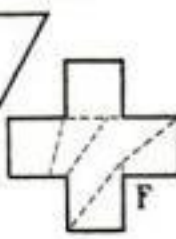
C



D



E



F

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THE study of the human mind is one of the newest of all sciences. Only in comparatively recent years have men attempted in a systematic way to penetrate the mysteries of our thought processes.

Doctor Johanson is one of the leading exponents of this new science, which little by little is revealing fascinating secrets about our thinking machinery. Have you enjoyed the tests he has presented here? Have they stimulated you and helped you? If so, you won't want to miss other equally entertaining and valuable mental exercises that will appear in subsequent issues of POPULAR SCIENCE MONTHLY. Watch for them.



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"Years ago, when one entered the building business, it was necessary to start at the bottom and work up step by step. My start was to carry the water bucket and be a general helper, at \$3.00 per week. I learned by experience, and it took me many years. Often I have wished I could have had the easy, quick, thorough training offered to boys and men today. The Chicago Tech. School for Builders can teach the fundamentals of building, give every man in 10 months' training what took me about 10 years to learn in the slow, hard school of experience. Today this modern method enables every boy and man to obtain his training during spare time. Opportunities now in the building business are the best ever, growing greater every year. There is an endless opportunity for trained men. So writes Samuel Glassberg, greatest home builder of the northwest, Pres. Glassberg Construction Co., Minneapolis. A self-made man who plans, finances, and builds an average of 75 homes annually, and knows every branch of the building business. He started as a boy. Today he has his own lumber mills, finance company, and employs more than 180 men.

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Fifty Years a Coal Miner

(Continued from page 18)

time, so there's little fuss made about
them.

"It's care that's needed in dealing with
gas. In the old days many a miner went
into a heading that he'd left safe enough
the night before, and had his life snuffed
out the moment the naked flame of his
lamp came into contact with the explo-
sive gas that had worked free from the
coal during the night. Now, when the
headings are tested every day, there's
little danger of an explosion except when
a blast releases a big quantity of gas from
a reservoir in the coal. That's one of the
risks of mining.

"Speaking of gas reminds me of my
old friend, Joe Slatter. Joe was the most
careful miner I've ever known, and he was
afraid of fire damp—he'd been in a big
blow-up where a dozen lives were lost.
And he was an expert miner, and earned
good money, so what should he do, after
he'd got his house paid for, but buy him-
self an automobile.

"WELL, then, one night he didn't
come home, and in the morning
his wife went out to the garage he'd built
in his yard, and there sat poor Joe in his
automobile—stone dead."

There was a long pause. Then:

"Well," I asked, "what killed him?"

"The thing he was most afraid of—fire
damp," said old David triumphantly.
"Well, then, they didn't call it that, to be
sure, but a chemist once told me that the
main difference between fire damp and
the stuff that comes out of the exhaust
pipe of an automobile is the names they're
called by."

David Jones flashed his lamp on a
stout board door, pulled it open, and
stepped through. We went through a
short, dark passage and stepped out into
"Broadway," the main road of the level,
lighted at intervals by electric lamps, and
with its roof supported by iron rails
placed girderwise.

"Now, rock falls," continued David,
"are worse than gas. There's grim death
hanging over your head every minute
you're underground, and there's no telling
when it's going to drop on you—maybe
this minute, maybe not for twenty years,
maybe never. The roof that sounds solid
when the safety man tests it may be
down on the miner's head within an
hour. A blast, pressure from above, air
currents—a dozen things may cause a
rock fall at any time.

"THEY'VE trapped me in headings a
half dozen times. All you can do is
to sit tight and wait for them to mine in
to you. It's a race between the rescue
party and the amount of gas in the air you
must breathe. Of course, if the roof
comes right down on a man, he's what the
boys call 'out of luck.'"

From down the road came the clanging
of a bell and the flare of a torch. "Step
aside, then," said David. "Here's a safe
place." With a rumble and a clatter a
squat electric locomotive hauling a string
of mine cars passed us.

"Yes," said David in answer to a

(Continued on page 135)



Here's How

Take a tip from me! Six months ago I didn't
know one note from another. Today I am a well-paid
saxophonist! And I didn't have to part with a
fortune to attain my present success, either—
thanks to the marvelous course that the U. S.
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Easy Home-Study Outfit

That Method made good with me, all right. In a
short time I was playing real tunes and melodies,
not just scales. What's more, I played them well!
So well that even while taking my course I was able to
earn some extra money playing for entertainments.

Oh, yes, I made plenty of friends with my ability to
"jazz" up parties. I actually became popular—I who a
few short months before had wished I could play, if only to
while away the time. Time!
Every minute of my time is
now in demand. And I am
well paid for my pleasant
work.

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Fifty Years a Coal Miner

(Continued from page 134)

question. "we still use some mules, but electricity is driving them out of the mines. In places where the gas is bad enough to make a spark dangerous we use compressed-air locomotives. Those were loaded mine cars bound for the foot of the shaft, where they will be run on the cage platform and hoisted to the surface. And it's a quick trip up they'll make. We came down slow and easy, and will go up the same way, but when it's coal they're hoisting, the trip takes twelve seconds—and that's a speed no office-building elevator can match."

David turned briskly into a dark passage. A hundred feet farther on he turned again. Miners' lamps showed us two men at work on a breast of coal that gleamed dully in reflection of the restless lights. One of the men was holding a steel drill, the other swinging a sledge.

"THAT'S the coal," said old David proudly. "'Tis eighteen feet thick, solid except for a few thin layers of slate, and as fine anthracite as you'll find. They're getting ready to put in a shot of dynamite. Now that's another thing that requires a little care to be safe. There are three ways of firing a shot. The best is with an electric battery and a long wire. The next best is with a long fuse and a miner's lamp. The worst is with an acetylene torch, because you never can tell what it will do to the fuse."

"Miners, like every one else, like to save themselves time and trouble, and every year many of them lose their lives because they cut their fuses too short, or don't go back far enough when they fire their shots. Come back around the turn now—they're going to fire their shot."

After a little there came a dull rumble, and when David led the way back into the heading, the floor was covered thickly with great lumps of jet-black coal, which one of the men was tossing into a mine car while the other worked with a pick at the loosened coal in the breast.

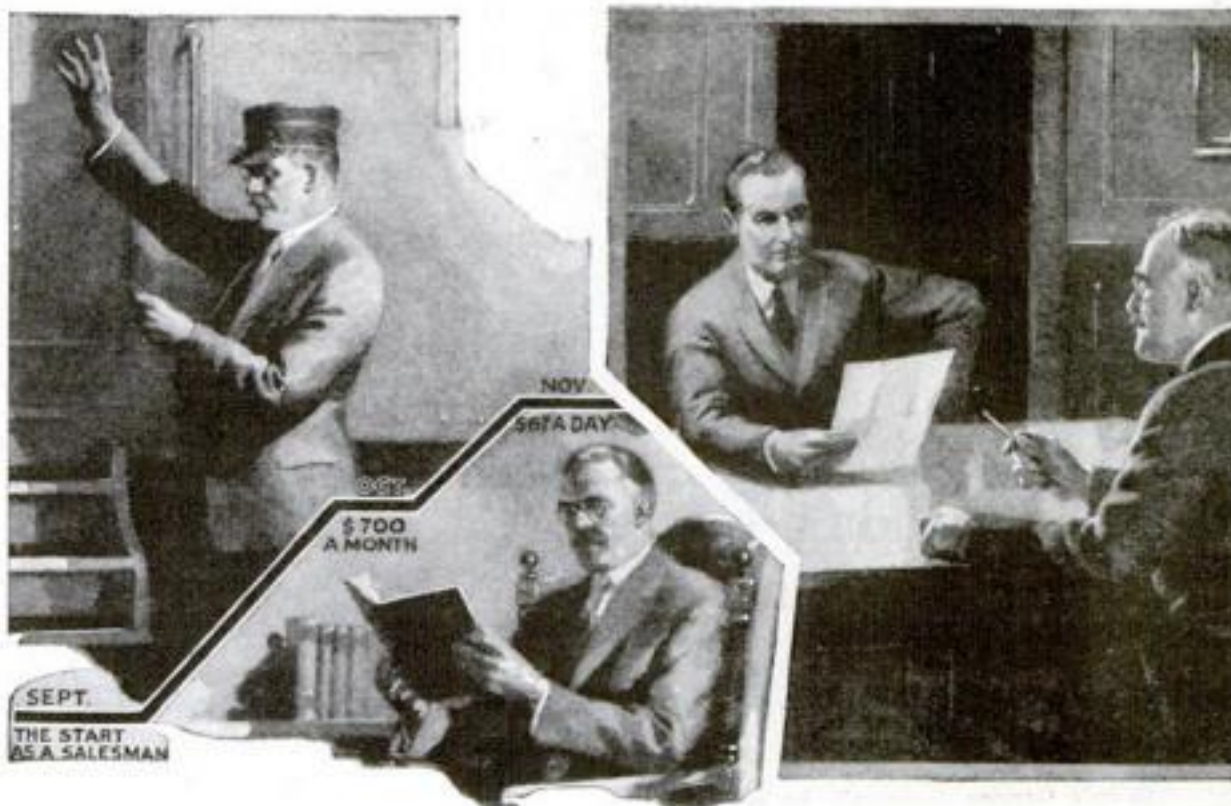
"YOU noticed," said David, after we had started for the shaft and the world above, "that the miner in there was using a hand drill. Well, then, next week he's going to buy himself an electric drill, and then he'll get more coal and bigger pay checks."

"How long will this coal last?" I asked.

"For fifty years they've been taking coal out of this mine," said David, "and fifty years from now they'll still be taking it out. Silting is what makes that possible. After a heading is worked clear of coal, waste or sand is washed into it by pipes from the surface, and forms a solid mass after the water is drained off. That prevents cave-ins, and makes it safe to take out nearly all the coal in a level."

We reached the shaft, and old David pulled the signal plunger and took his place with me on the cage platform. "Well, then," he said, "I hope I've not given you the idea that coal mining is a very dangerous business. I'll not deny that it has its risks—but what trade is free from them, then? For myself, I

(Continued on page 136)



FOURTEEN YEARS A CONDUCTOR Then Salesmanship and \$700 a Month

Do you know the quickest way to make dreams come true?—It's the salesmanship way.

For out in the **selling** field, if a man makes good, "raises" come to him automatically—and many times a year. There was C. A. Thomas, for example.

Thomas, a California man, had been a conductor on a railroad for fourteen years. "One day," said Mr. Thomas, telling of his experience, "I came in on my passenger run and never went out again. Instead, I undertook to sell real estate. The first month I did not make a sale. I saw that I needed something to help me, and I believed I would find it in LaSalle's training in Modern Salesmanship. You can judge for yourself the aid it gave me when I tell you that the next month I cleared \$700, and last month I averaged better than \$67 a day throughout the month."

J. J. Graney writes of similar success. He was a mail carrier when he enrolled with LaSalle.

"I have not worked nearly so hard since I have been selling," writes Graney, "but have increased my earning power about 400 per cent. During September I earned \$225, October \$500, November close to \$700, and I expect to make \$1,000 this month."

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tained in this book is of priceless value to the man seriously ambitious to make a real success in the selling field. And—the coupon brings it to you, **free**. If your future is worth a two-cent stamp and two minutes of your time—place the coupon in the mail **TODAY**.

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Fifty Years a Coal Miner

(Continued from page 135)

wouldn't trade jobs with President Coolidge himself."

The cage began to move. The light at the level entrance faded into nothing, and blackness clutched at us again. But this time the journey did not seem so long, and soon the swaying cage shot upward into the good light of day.

David pointed to where a huge breaker building stood bleak against the gray sky. "That's the last stage of mining," he said. "There the coal is broken, and sorted into sizes for the market."

It still was raining when I shook hands with David Jones.

"When you get to your hotel, then," he advised kindly, "be wise and get your feet into some dry socks and shoes. It's this cold and wet above ground that's the ruination of a man's health."

Could it have been a sly twinkle that I saw in David's old eyes as the cage bore him swiftly back into the earth?

Saves Gas for Airships

TWO professors of chemistry in the University of Berlin, claim to have solved the problem of flying and landing airships without releasing the gas. Where hydrogen gas is used, this blowing-off process is dangerous; and where ships use helium, it is expensive. By the new method the gas with which the airship is inflated is heated electrically. The gas thus expanded cools gradually as the ship's load is lightened through the use of fuel.

The new process, it is claimed, automatically changes the gas volume, necessary in different altitudes and air pressures, without releasing gas that may be needed later in the same flight.

It is claimed the new method will save half a million dollars a year in operating a big ship, such as the *Los Angeles*, with helium.

Beware of the Radio Battery Gyp!

(Continued from page 66)

battery. It is manganese dioxide ground up with powdered carbon. You have to use the best grade of material and grind it just right to get good results.

There is another funny thing about dry cell batteries. For years people have been insisting on testing dry cells with an ampere meter. The dealer snaps the meter on the battery and when the hand goes around to 25 amperes or so, the customer admits that the cell is a good one. As a matter of fact, the amount of current that will flow out of a dry cell A battery on a short-circuit test of this kind doesn't tell you anything about how long it is going to run your radio set. Anybody can turn out gyp batteries that will show a high ampere meter reading, but the trick is to make 'em so that they will keep on delivering current to your radio tubes as long as possible.

How are you going to steer clear of "gyp" batteries? That's easy. Keep away from fellows who always advertise cut prices, and remember that the manufacturer's name and the dealer's reputation are reliable guides when buying batteries.

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He Made Himself Strong

(Continued from page 19)

discoverer and pathfinder. He worked out a systematic series of exercises with dumb-bells which, he proved, would develop not only the visible external muscles of the body, but the internal muscles that support the walls of the chest and give the heart and other vital organs endurance against the strain of strenuous life.

A few of these exercises are illustrated here. They can be practised either with dumb-bells or without. Some of them you probably will recognize immediately, especially if you are among the thousands who get up early every morning to join a radio gym class, or who follow the "daily dozen" played by the phonograph. For many of the health building exercises we practise today are simply modern versions and variations of the science that Sandow applied to make himself the world's strongest man, and that he passed on to the rest of us some 30 years ago.

SANDOW once said that he expected to live one hundred years, and to be as strong as ever when he reached the century mark. That he was cut short in his fifty-eighth year was due perhaps to his overabundance of vigor and his confidence in his own power. His death, according to reports, was the result of straining himself while lifting an automobile, single-handed, from a ditch. Perhaps, in his great strength, he forgot that men do grow old, and that muscles do wear out with time.

His own physical training consisted almost entirely of dumb-bell exercises and walking. From my own experience I can testify that the system worked. Before I began his method of training, I weighed about 140 pounds, and the ordinary exercises with five-pound dumb-bells soon tired me. At the end of a few months my weight had increased to 165 pounds and I found myself able to lift a 100-pound dumb-bell above my head with ease.

"My plan is so simple a child can understand it," Sandow would say. But in promising that any ordinary man could equal him in strength he included certain important conditions. First of all, he found, it was necessary to possess a determination to grow strong. In his own case, this determination amounted to a passion that was not to be denied. As a boy, in Königsberg, Prussia, he abandoned himself to sports and athletics until he became skilled as an amateur gymnast and wrestler. In this he acted directly against the wishes of his father, who had determined that Eugene should become a minister.

WHEN his father forbade him to go to the circus, the youth would steal away to the big tent and the wrestlers' arena, there to dream of matching his strength with the strongest. And when, in a final quarrel, his strict parent cut off his money allowance, the young Sandow's ambitions remained unshaken, even when he felt the pinch of poverty. Already his assets in life were a trained body, molded to almost perfect proportions, skill as an athlete, and unusual strength. He turned

(Continued on page 138)



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He Made Himself Strong

(Continued from page 137)

to the circus and theater for a livelihood, traveling from town to town through Belgium and Holland.

Once, in Amsterdam, he found himself penniless and without a job. He pawned everything he owned of value. When this money was gone, he was sorely tempted to return home at his father's invitation. But in the end he refused. He stuck to his ambition.

IN THE emergency Sandow hit upon an ingenious but desperate scheme to make himself known and get a job. Throughout the city were scattered weight-lifting slot machines on which the Dutch youths were accustomed to test their muscles. Enlisting the confidence of a cabman, from whom he borrowed enough small change to insert in the slot machines, Sandow drove through the streets in the dead of night, from one machine to another; and each machine in turn he wrecked with a single pull on the handle!

The whole city was aroused, and a reward was offered for the capture of the "band of vandals" whose combined strength was believed to have been responsible for the outrage. When, on a succeeding night, Sandow was arrested with the cabman on suspicion, and confessed that he had wrecked the machines single handed, the police laughed in his face. Only when he demonstrated his great strength by laying low one of the biggest town constables was he able to convince them. Immediately he became a hero, and a theater owner who at first had refused him a job signed him up for a long engagement.

On another occasion a professor of anatomy at the Académie des Beaux Arts in Paris abruptly refused him a job as a model. The professor, turning away from him, was mounting the stairs to his classroom when Sandow suddenly seized the man's legs, and lifting him as he would a child, set him down again beside him. Sandow got the job.

ANOTHER requisite, besides determination, which Sandow laid down for the man who would grow strong, is concentration.

"It is the mind—all a matter of the mind," he would tell his pupils. "The muscles really have a secondary place. If you lift a pair of dumb-bells 100 times a day with your attention on some object away off, it will do you little good. If, however, you concentrate your mind upon a single muscle or set of muscles, for three minutes a day, and say 'do this and so,' and they respond, there will be immediate development."

I know it to be a fact that there was hardly a waking moment when Sandow was not exercising one or more of his muscles. Even while sitting down reading a paper he would keep his muscles moving all the time. It was to teach the value of such concentration that he invented a dumb-bell with a spring grip that required the user to give attention to movements of hands and fingers while exercising other muscles of the body. The elastic exerciser that many of us have

(Continued on page 139)



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MR. C. E. BROOKS

He Made Himself Strong

(Continued from page 138)

hung on the wall in our homes was another of his inventions designed to aid concentration on the development of particular sets of muscles.

BUT concentration of itself, Sandow emphasized, was of little value unless accompanied by a thorough knowledge of the machinery of the human body.

"The very secret of my system," he once said, "lies in knowing just where you are weak, and going straight to work bringing that particular part up to the standard of your best feature; for there is a best feature in every man, as there is also a worst. Knowing your weakness, the secret is to concentrate your mind and energies on that weakness with a view to correcting it."

From the time he was a boy of 16, Sandow never ceased to be fascinated by the study of the body. At the University of Göttingen, and later in Brussels he specialized in anatomy. And it was his close knowledge of his bones and muscles, their functions and their power that enabled him, at the age of 23, to leap into world-wide fame almost overnight.

His great opportunity came at the Westminster Royal Aquarium in London, where a giant named Samson, who titled himself "the strongest man in the world," had offered a challenging £500 stake to any man who could duplicate his feats. At this time, Sandow had gained considerable success on the Continent. In Rome, he had attracted the attention of King Humbert by his performances, which included the defeat of the noted Italian wrestler Bartoletti. In Milan, he had opposed three wrestlers in one match and had vanquished them all. Thus far, his feats of strength had been confined mostly to weight lifting and wrestling.

BUT in London the great Samson offered something entirely different. Among other feats he would break heavy chains by the expansion of his chest, and snap iron bars across his legs. Never had Sandow attempted such feats when he climbed into the ring on that memorable November night in 1889 to take up Samson's challenge. But he entered with a confidence that amazed the audience of sportsmen. For he knew himself. He knew what his mighty sinews could do if put to the test. He called them into play and they responded. The great chest heaved. The chain parted.

Not only did Sandow duplicate every performance of Samson, but he added a few of his own in weight lifting that baffled "the strongest man on earth."

From that night Sandow's reputation was assured. Then began a series of exhibitions in England, Scotland, and finally in America. And everywhere he was idolized.

No doubt many of you recall the sensation of his opening engagement at the famous Casino in New York City, or his subsequent performances in Boston and Chicago. Perhaps you recall how he would lift above his head with one hand a huge dumb-bell containing two men, one in each sphere, or how he would

(Continued on page 140)

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He Made Himself Strong

(Continued from page 139)

balance three horses standing on a plank on his chest, or how he would lift a 500-pound weight with his little finger.

But other events, never to be forgotten, were the receptions held in the theater after his regular performances, or in aristocratic mansions, attended by men and women of high society. Sandow always took enormous pride in his muscles, as if they were some great masterpiece of his creation, and it pleased him to exhibit them. I can see his handsome figure yet as he strode from his dressing room like a statue of Hercules come to life, his rather short body straight and massive, his head covered with a mass of thick golden curls.

HE WOULD pass quickly from one member of the select company to another, bidding each in turn to test his biceps or sound the depths of his great muscle-armored chest.

"You may think my muscles are always hard," he would say to one of the ladies. "But feel my arm now." She would clasp her two daintily gloved hands around his arm and would express surprise to find the flesh quite soft. "Well, now we'll harden it," he would say, and instantly the muscles would swell into ridges as hard as steel.

If Sandow was proud of his strength, he was not lacking in courage. One of the most amazing things I ever saw him do occurred in San Francisco in 1895 after we had formed a partnership in which I did the publicity work, and he the weight lifting. There was an animal show in town, and we arranged to stage a fight between Sandow and a lion in a circus tent I erected on Market Street. The night before the event a trainer who entered the lion's cage was torn to pieces, and so you can imagine the size of the crowd that came to the show the next day.

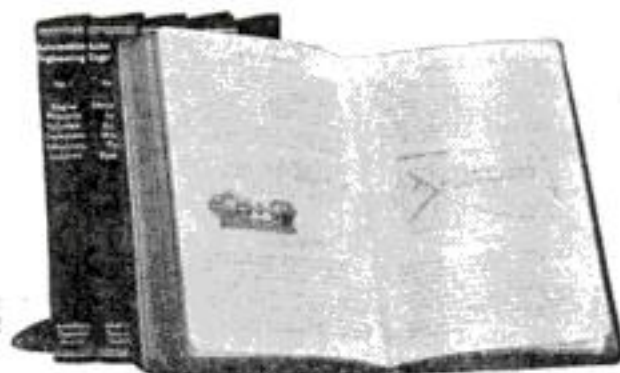
The place was packed when, just as the lion was being transferred in a wooden box from a wagon to the tent, the beast escaped. Every showman not engaged instantly grabbed tent stakes and clubs, forming a line of defense to keep the lion from rushing into the main tent and causing a panic.

JUST then Sandow came along. Without hesitating, he walked right up to the lion, grabbed him by the throat, and tail, and carried him back to the box.

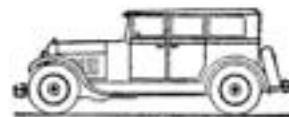
And when, a few minutes later, Sandow stepped into the cage for the big fight, the lion gave one look at him, then turned about and stuck its nose in the sawdust. It wouldn't move. Sandow picked it up by the tail and carried it around the cage.

Sandow never believed in training, as the term is understood among football players and track athletes.

"People who eat only by rule are foolish," he once said. "They go into what they call training before a fight, and when it comes to the occasion they can hardly stand up. Then it is a question of which is the most starved man as to who goes under. I do nothing to excess. I drink what I like, I eat what I like, I smoke all I like, but it is not to excess."



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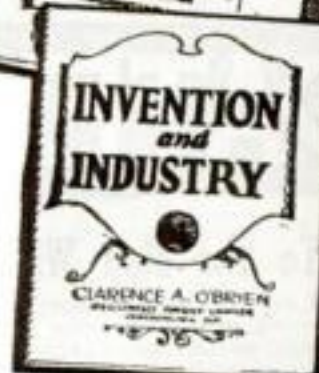
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(Continued from page 52)

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World's Strangest Firemen

(Continued from page 30)

told me, "are quite common. This happens when a building near one that is burning, gets so hot that the wood in it becomes carbonized and bursts into flame, even when no spark or fire has come in contact with it. Woodwork too near a radiator will sometimes dry out, become carbonized and catch on fire."

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"Have you heard of the nurse who was caring for a patient with severe burns? After oiling his body she covered him thoroughly with blankets. A victim of spontaneous combustion, he came to a tragic end."

"Not long ago a candy factory in Virginia had a mysterious fire. It seemed to originate in a pile of a peanut skins; not shells, but the thin red nut skins. That didn't seem possible, even to us, but investigation showed that particles of the nuts sticking to the skin amounted in the aggregate to a quantity of oil, and it was quite probable that the skins had ignited spontaneously."

"Anything, everything, can cause fires," said Mr. Muldaur. "To prevent and fight them require the hardest work and constant care."

British Wireless Planes

THE first stage of success with wireless controlled airplanes is said to have been reached recently in England. The authorities carefully camouflaged these tests, but an accident revealed the secret. The tests were made near an airplane station on the south coast, but the inhabitants of the town never suspected that the planes they saw flying over the sea carried no men. Some weeks ago a monoplane, one of the three machines used in the experiments, became unmanageable and crashed to the shore. Then the secret was out.

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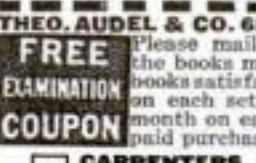
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The Dumbest Genius

(Continued from page 38)

In any intelligence test the spider ranks low. The experiment with the bundle of eggs and the cork pellet has already demonstrated this. Sometimes the spider will miss her aim when trying to deposit her eggs in her half-finished nest. It would seem certain that she must have seen them fall to the ground, but she continues laboriously to finish the nest and seal it up carefully.

APPARENTLY the spider's instinct has dominated her intellect. The great French naturalist, Fabre, took a burrow-building type of spider from her home in the ground, and put her in a cage, where there was plenty of earth. If he started a burrow for her, she would complete it and make a perfect home. But if he left the ground untouched, the spider would pine away and die, rather than start a burrow. Fabre's interpretation of this was that the spider being accustomed to building but one burrow in her lifetime, would not build another one, even though her stubbornness meant her death. When one already had been started for her, she seemed to be under the impression that she was merely improving her old home.

The spider's mind can work forward to new improvements, but cannot retrace its steps and start the process all over again.

Many of the spider's actions can perhaps be traced to poor eyesight. She has eight eyes, but they seem to do her little good, either singly or collectively. They are immobile, and each is composed of one large lens. There are no eyelids. There are few nerve endings, and the spider can probably discern only motion, form, and perhaps color.

There is little doubt that a spider hears, but how still remains a mystery. As for sense of smell, careful experiments have indicated that the spider can distinguish between odors. The sense of touch, of course, is developed very highly. Her sense of taste has never been determined.

BESIDES these five senses, the spider seems to have a sixth sense—a sense of self-protection. She needs it, for the voracious birds and the murderous digger wasps are her sworn enemies. There is no escape, once they find her. So she resorts to the most elaborate stratagems to avoid detection.

One species, inhabiting the shore lines of the Pacific, may be found at low tide crawling around on the rock and coral reefs. But when the tide rises, you search for them in vain. Where have they gone? The answer is an amazing one. Each spider, when the tide starts to come in, takes refuge in a crevice and spins over her retreat a sheet of silk, impervious to water. Here she lies in safety with a supply of air until ebb tide exposes the site again to the sun.

Despite all we know about the spider, she is still much of a mystery.

Can any spider's poison kill a man? That is still an unsettled question, though most scientists believe the answer is "no."



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It May Pay You to Burn Oil

(Continued from page 26)

this item to suit the rate you are paying the kilowatt hour.

The roaring noise produced by an oil burner, combined with the humming of the electric motor blower, is a factor that deserves careful consideration. It is most objectionable, of course, to persons of a high-strung, temperamental disposition. The construction of the house, and location of the heating plant in relation to the living- and sleeping-rooms, will govern the disturbing effect of the noise.

FOR equal heat content, oil occupies 50 per cent less space than coal and has 25 per cent less weight. It can be stored at a distance from the furnace, thus releasing considerable cellar space.

Fire risk must be considered carefully in connection with oil burners. However, reliable manufacturers of equipment for burning oil have incorporated safety devices in their product to such an extent that a modern installation is rated nearly as safe as a coal furnace.

It is well to avoid any oil burning apparatus that has not been approved by the Underwriters' Laboratories.

The manifest advantages of oil as a fuel for home heating undoubtedly will result in a great increase in demand for grades of oil suitable for this use. It is probable, therefore, that the price of fuel oil will increase faster than the price of coal. Remember that a price increase of one cent a gallon for fuel oil is equivalent, as far as the home owner's pocketbook is concerned, to more than a dollar a ton increase in the cost of coal.

Do not, under any consideration, allow any one to persuade you to install a fuel oil burning outfit fitted with a small storage tank for oil. Equipments have been made and marketed with a 50-gallon tank placed in the cellar. That much oil is equal to less than a half ton of coal, and no home owner would be satisfied with a half-ton coalbin. Insist on a large tank buried beneath the ground outside of the house. This cuts the fire risk and makes it possible to have enough oil to heat your house for many months. It also enables you to take advantage of the price fluctuations in the cost of fuel oil. Nearly all the larger cities have regulations covering oil burning installations that will tell you what to do.

The Technical Editor of **POPULAR SCIENCE MONTHLY** will be glad to answer questions from readers concerning oil burning installations. If you write for information, be sure to give the fullest possible details about your present heating system, the size of the house, and the type of construction. Letters may be addressed to the Editor, **Popular Science Monthly**, 250 Fourth Avenue, New York City.

Radio "Fading" Persists

MERELY increasing the power of a radio broadcasting station will not prevent the signals from exhibiting the phenomenon known as "fading." This is the conclusion reached by the U. S. Bureau of Standards as the result of recent tests.

Does Your Car Fit Your Purse?

(Continued from page 68)

vile smelling pipe. "That's a heck of a way to tell a fellow to economize! Still—lots of men would rather ride fifty miles in a heavy car than a hundred in a light one. Tell you what, though, Baldwin, you can economize right now by doing most of the repair work on this car yourself. You are right handy with tools and I've got more work than I can handle anyhow. In fact, I really couldn't get at your car till next week."

"I WONDER if I could?" mused Baldwin. "By jinks, I'm going to try it! It's either that or go without lunches."

"Go to it," Gus encouraged. "If you get stuck, we can always help you out."

"Thanks for the advice, Gus. I'll take the boat home and make a start tonight," said Baldwin more cheerfully.

"By the way, Joe, speaking about the cost of running a car, you seem to have all the dope right at the end of your pencil. Why not show me a good way to keep track of how much it's costing me to run the bus?"

"That's easy," replied Joe, pulling out his notebook. "Of course there have been a lot of systems worked out to keep auto records and some of them are fine, but so complicated."

"My system, though, is really nothing but a logbook such as the mate of a ship keeps. Only I use the miles on the speedometer instead of the dates on the calendar. It is so simple that you don't need any complicated forms, and you can make it just as complete as you want."

"Take one page in your notebook and label the column at the left 'miles.' Mark the next column 'gas,' the third 'oil,' the fourth 'tires,' and the fifth 'repairs.' Keep your notebook handy and whenever you buy gas or oil, or have a tube vulcanized, or any repair work done, put down the miles your speedometer shows and the amount and cost of the gas or whatever it is that you are spending money on. For instance, suppose you make a stop for gas. While the gas is being pumped into your tank you'll have plenty of time to make a note of it."

"WHAT about those other expenses you mentioned—depreciation, insurance, and so forth?" Baldwin inquired as Joe paused to catch his breath.

"I don't put those down on my regular auto log page," answered Joe. "I use another page and simply jot down each item as I pay for it, with the date and the speedometer reading. That applies to everything except depreciation. You can't tell what depreciation amounts to until you have sold or junked your car."

"Everything about a car can be figured on a mileage basis except depreciation. Theoretically at least, depreciation is determined by the number of miles you travel, but that applies only when you own and run the car for its entire useful life. If you sell it while it still is useful, the amount you must charge up against the miles you have driven will depend on

(Continued on page 148)

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Does Your Car Fit Your Purse?

(Continued from page 147)

what you get for the car when you sell it and that, in turn, is dependent on the condition of the secondhand market.

"Mechanical depreciation—the actual wearing out of the parts of the machine—also depends to a large extent on how carefully you use it. I mentioned a few minutes ago that your car would be worn out in five years, figuring 30,000 miles of use during that time. That estimate is based on just ordinary care. With extra care, you may be able to more than double that mileage before the car is ready for the junk pile.

"THAT seems clear enough," agreed Baldwin; "but how does it help you to cut mileage cost just to put down the gasoline you buy?"

"Well," replied Joe, "It tells you one thing and that is the actual mileage you are getting out of the gas. Lots of fellows claim high gas mileage. Most times they are talking through their hats. They have no figures to prove it, and if they did make an actual test, it was under favorable conditions.

"If you keep your record my way, you can get the real facts in the case any time you want them. Just add up the column of gas purchases and divide the result into the miles you have covered. In this way you can tell how many miles you get in winter or in summer, and if you check up every month or so, you can tell pretty well when your car needs repairs.

"If, for instance, you notice a sudden falling off of two miles to the gallon that you can't account for by a cold spell or lots of short runs, you can be pretty darn sure that something needs attention. I discovered a worn out rear axle bearing that way—or rather Gus did it for me. I noticed that I was not getting the full number of miles to the gallon, and Gus found that the bearing had worn so that it let the brake band up where it was rubbing against the brake shoe.

"ANOTHER time I noticed that the motor was using less oil than usual. That seemed funny to me, so Gus looked into it and found a small piece of brake band had come off and partly clogged up the oil pipe. Enough oil got through to keep the motor from heating up, but if I hadn't found it in time, the lack of oil would have raised hob with the motor."

"I'm convinced, all right," said Baldwin, pulling out his own notebook and thumbing it over to find a couple of blank pages. "I'll never spend another cent on this bus without entering it in my log, you can bet on that. Well, I guess I'd better be running along now. I'm going to tackle the motor first."

"Say, Gus," said Joe after Baldwin had left, "what's the idea of passing up a good job like that?"

"Forget it!" Gus growled. "We've got plenty of work now. Besides, the kid can't afford it."

"Humph!" replied Joe with a twinkle in his eye. "That's a new one on me—a soft hearted guy in the garage business!"

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They Laughed at Him

(Continued from page 21)

a "harmonic telegraph" and with which, by making use of sympathetic vibration, he hoped to achieve multiple telegraphy; that is, to send half a dozen or so Morse messages over a single wire at once, without interference. It was for this that he enlisted the aid of Watson, the young mechanic, and moved his workshop to a garret above an electrical supply shop where Watson worked.

FOR months that extended into years the two young men struggled with the harmonic telegraph, but never were they quite able to make it behave. Yet it was through their dogged persistence in the face of repeated failure that the whole secret of the telephone suddenly came out of hiding and revealed itself to Bell in one dramatic instant.

Briefly, the transmitter and receiver of the harmonic telegraph each consisted of a flat piece of steel clock spring attached to an electromagnet in such a way that when the current was on, it would vibrate with a sort of whine at a certain pitch. In addition, make-and-break points were provided to break up the whine into the dots and dashes of Morse messages.

The idea was to use several pairs of these instruments on a single line, each pair tuned to vibrate sympathetically without interfering with any of the rest. Thus by careful tuning of the instruments it might be possible to send any number of messages simultaneously.

The only trouble was that the messages persisted in getting mixed up because of inaccuracies in tuning. In the experiments Watson would handle the transmitting end, while Bell, in another room, would do the tuning.

One sweltering afternoon in June, 1875, the two were hard at work in the hot garret, busy at the endless job of testing. Everything seemed to be discouragingly out of harmony. Watson was making the transmitters whine while Bell was retuning the receiver springs one by one. All at once one of the transmitters stopped vibrating. Watson plucked it with his finger to start it again. It wouldn't start, so he kept on plucking.

SUDDENLY there came a shout from Bell and he rushed in excitedly from the next room.

"What did you do then?" he cried. "Don't change anything! Let me see!"

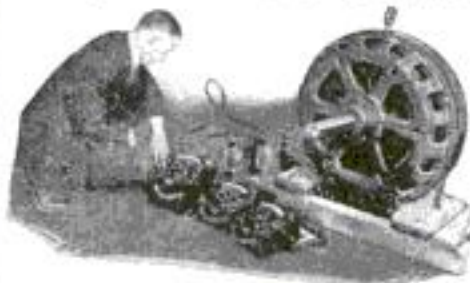
Together they examined the instrument. They found that the adjusting screw had been set so tightly that it held together the make-and-break points of the transmitter spring. And so, when Watson had plucked the spring, the circuit remained unbroken. At the same time the vibration of the magnetized strip of steel over the pole of its magnet had brought to fulfillment the great dream of Bell. It had generated "a current of electricity varying in intensity precisely as the air varies in density during the production of a sound." That current had passed through the wire to the next room, and there the receiver had caught and transformed it back into a

(Continued on page 150)

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They Laughed at Him

(Continued from page 149)

faint echo of the sound of the vibrating spring. Bell's marvelously trained ear had caught that echo and had recognized its significance.

That was the birth of the telephone. It was the kind of revelation that would have passed by any other man than Bell unnoticed. But he, trained and schooled in the intricacies of sound, recognized instantly that if the complex vibrations of one sound could be transmitted, speech could be transmitted likewise.

THAT night the first model of a speaking telephone was built by Watson at Bell's direction. But when they tried it out the next day, though it made strange noises, it wouldn't speak a word!

There followed more days and nights of experiments, and it was not until nine months later—on March 10, 1876—that the telephone spoke its first complete sentence. What it said was this:

"Mr. Watson, please come here, I want you."

And Watson, down in the basement, ran up three flights of stairs three steps at a time to get there.

"I can hear you!" he yelled. "I can hear the words!"

How Large Is an Electron?

WHEN we consider that nobody ever has seen an atom because atoms are far too small to be seen through even the most powerful microscope and that, notwithstanding their extreme smallness, atoms are complex structures consisting of a nucleus and a number of electrons varying in number according to the element of which the atom forms a part, we naturally reach the conclusion that electrons must be infinitesimally small. The following statements, based upon scientific calculations, may help to form a clearer conception of the size and weight of electrons.

The number of electrons that passes in one second through a conducting wire when an electric current of one ampere (just about enough to feed two or three incandescent lamps) is sent through that wire, is estimated at 8,000,000,000,000,000,000. Supposing that number of electrons were spread out evenly and at regular intervals upon a plane surface allowing to each electron a space of 1 square inch, they would require a space greater than the area of North America. In view of the fact that many billions of electrons could find room on a single square inch, the entire number of electrons could be placed, without crowding, on a surface of possibly a foot square. Their total weight would be not more than one-hundredth part of a milligram.

Hookworm Spreads to Palestine

MODERN methods of agriculture are blamed for the introduction of hookworm into the Holy Land. Doctor A. Felix of the Rothschild Hospital in Palestine, who found that about one out of every 12 workmen in the orange groves is affected by the disease, attributes it to the increased use of irrigation in the land.



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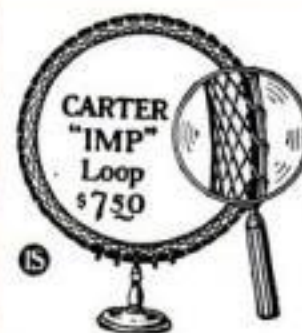
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Here Are Correct Answers to Questions on Page 56

1. No. If anything they are more healthy. Prehistoric skeletons, as well as the mummies of the ancient Egyptians, show that ancient men suffered from many of the same diseases as we do.
2. When things are hot, they swell a little, they expand. The quicksilver in the thermometer does this and the glass tube and scale are merely devices that show us just how much the quicksilver has expanded.
3. Because it is one of the few liquids that will not freeze at the ordinary winter temperatures of inhabited countries. At about 40 degrees below zero, Fahrenheit, even quicksilver will freeze. Below this some other liquid must be used, for example, alcohol, which freezes only at about 175 degrees below zero.
4. Because it has no air and no water, at least in liquid form, and because it is so cold.
5. This is a device of nature to protect the delicate tissues underneath the skin while a new skin is being formed. Some watery serum from the blood seeps out underneath the place where the skin was burned and lifts the dead skin away from the living tissue below. A new skin then forms underneath this water cushion.
6. Because the little particles of smoke and dust in the air serve as something for the water molecules to condense on. It is easier for the molecules to get together and form droplets if there are already a lot of small solid particles in the air.
7. By evaporating some of the water out of it. But this cannot be done by heating it. This would give the milk a cooked taste. So the water is evaporated by putting the milk in a vacuum where the water can be boiled off without heating.
8. Because sound travels faster and farther through the ground than through air. With your ear to the ground you can hear marching men or running horses a long way off. During the war the Allied scientists perfected instruments to magnify the very faint sounds transmitted thus through the ground. They could detect troop movements and the like far behind the German lines.
9. No. It blooms much more frequently than this, though it sometimes happens that 25 or 30 years will pass between two bloomings.
10. Milk contains millions of droplets of oil and fat. These are lighter than water, but because they are so very small they float up in it only very slowly. When the milk stands a while, they do rise and make the cream. When you churn milk, all these droplets get together and make the butter.
11. Nearly five million cubic miles of it; enough to cover the entire United States with a layer of salt over a mile and a half thick.
12. Whales are not really fish. They are mammals and belong to the same group of animals that we do. They breathe air and cannot breathe water. They have developed an ability to dive and to stay under water for some time, but they do so just as human divers do by increasing their lung capacity so that they can take a large amount of air at one breath.

WHAT I THINK OF PELMANISM- Ben B. Lindsey

PELMANISM is a big, vital, significant contribution to the mental life of America. I have the deep conviction that it is going to strike at the very roots of individual failure, for I see in it a new power, a great driving force.

I first heard of Pelmanism while in England on war work. Sooner or later almost every conversation touched on it, for the movement seemed to have the sweep of a religious conviction. Even in France I did not escape the word, for thousands of officers and men were *Pelmanizing* in order to fit themselves for return to civil life.

When I learned that Pelmanism had been brought to America by Americans for Americans, I was among the first to enroll. My reasons were two: first, because I have always felt that every mind needed regular, systematic, and scientific exercise, and, secondly, because I wanted to find out if Pelmanism was the thing that I could recommend to the hundreds who continually ask my advice in relation to their lives, problems, and ambitions.

In the twenty years that I have sat on the bench of the Juvenile Court of Denver, almost every variety of human failure has passed before me in melancholy procession. By failure, I do not mean the merely criminal mistakes of the individual, but the faults of training that keep a life from full development and complete expression.

PELMANISM THE ANSWER

If I were asked to set down the principal cause of the average failure, I would have to put the blame at the door of our educational system. It is there that trouble begins—trouble that only the gifted and most fortunate are strong enough to overcome in later life.

What wonder that our boys and girls come forth into the world with something less than firm purpose, full confidence and leaping courage? What wonder that mind wandering and wool gathering are common, and that so many individuals are shackled by indecisions, doubts, and fears?

It is to these needs and these lacks that Pelmanism comes as an answer. The "twelve little gray books" are a remarkable achievement. Not only do they contain the discoveries that science knows about the mind and its working, but the treatment is so simple that the truths may be grasped by anyone of average education.

In plain words, what Pelmanism has done is to take psychology out of the college and put it into harness for

the day's work. It lifts great, helpful truths out of the back water and plants them in the living stream.

As a matter of fact, Pelmanism ought to be the beginning of education instead of a remedy for its faults. First of all, it teaches the science of self-realization: it makes the student discover himself; it acquaints him with his sleeping powers and shows him how to develop them. The method is exercise, not of the haphazard sort, but a steady, increasing kind that brings each hidden power to full strength without strain or break.

PELMANISM'S LARGE RETURNS

The human mind is not an automatic device. It will not "take care of itself." Will-power, originality, decision, resourcefulness, imagination, initiative, courage—these things are not gifts but results. Every one of these qualities can be developed by effort just as muscles can be developed by exercise. I do not mean by this that the individual can add to the brains that God gave him, but he can learn to make use of the brains that he has instead of letting them fall into flabbiness through disuse.

Other methods and systems that I have examined, while realizing the value of mental exercise, have made the mistake of limiting their efforts to the development of some single sense. What Pelmanism does is to consider the mind as a whole and treat it as a whole. It goes in for mental team play, training the mind as a unit.



Judge Ben B. Lindsey

Judge Ben B. Lindsey is known throughout the whole modern world for his work in the Juvenile Court of Denver. Years ago his vision and courage lifted children out of the cruelties and stupidities of the criminal law, and forced society to recognize its duties and responsibilities in connection with the "citizens of to-morrow."

Its big value, however, is the instructional note. Each lesson is accompanied by a work sheet that is really a progress sheet. The student goes forward under a teacher in the sense that he is followed through from first to last, helped, guided, and encouraged at every turn by conscientious experts.

Pelmanism is no miracle. It calls for application. But I know of nothing that pays larger returns on an investment of one's spare time from day to day.

(Signed) Ben B. Lindsey.

Note: As Judge Lindsey has pointed out, Pelmanism is neither an experiment nor a theory. For almost a quarter of a century it has been showing men and women how to lead happy, successful, well-rounded lives. 550,000 Pelmanists in every country on the globe are the guarantee of what Pelman training can do for you.

No matter what your own particular difficulties are—poor memory, mind wandering, indecision, timidity, nervousness, or lack of personality—Pelmanism will show you the way to correct and overcome them. And on the positive side, it will uncover and develop qualities which you never dreamed existed in you. It will be of direct, tangible value to you in your business and social life. In the files at the Pelman Institute of America are hundreds of letters from successful Pelmanists telling how they doubled, trebled and even quadrupled their salaries, thanks to Pelman training.

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IN SPITE of the size, weight, and power of an automobile, a small amount of dirt may put it completely out of commission. If dirt collects between the breaker points, for instance, it will prevent them from making contact and the engine cannot run until the dirt is removed. Lodged in the spray jet of the carburetor, the dirt will spoil the mixture and the engine will stop at once.

There is one place, however, where a small amount of dirt in the form of hard carbon will spoil completely the smooth running of the motor at low speeds and yet the effect is so peculiar that the motorist often fails to diagnose the trouble properly.

In all auto motors, carbon forms on the stems of the exhaust valves. This hard layer of carbon increases the size of the stem and the condition gradually becomes worse, until finally the valve stems stick in the guides and prevent the valves from seating properly. This happens only after the motor has warmed up fully and the heat of the exhaust has expanded the stems of the valves.

A test of the motor compression by turning over the engine by hand will not show poor valve seating because the stems cool off as soon as the motor stops. The skipping and missing also disappear when the engine is speeded up, because the compression in the cylinders is raised enough, when the throttle is open, to force the valves to a seat.

Scraping or burning out the carbon does not remedy the trouble, and the only way to cure it is to remove the exhaust valves and after scraping off the hard scale on the stems with a dull knife, polish them with a bit of crocus cloth to hinder the formation of a new deposit. Aside from the poor economy that results when a motor is allowed to run too cool, a low motor temperature greatly increases the amount of carbon deposited on the exhaust valve stems.

How Hot Is a Man's Hat?

DURING a heat wave in Paris recently a group of scientists held an investigation to find out how hot hats were. The experiments were made at a temperature of 97° F. The sporting cap was found to be hottest of all, with a heat beneath it of 98.6 degrees. The derby was next at 92 degrees. Felt hats showed only 86 degrees and the stiff straw 79 degrees. The panama won over all with only 77 degrees—20 degrees cooler under the hat than outside.

Redwood Yields Small Fortune

FOR many years a huge redwood tree lay partially embedded in the sand of the seashore at Salem, Ore. Picnic parties built fires against the log. It was salvaged recently by a native, who estimates that he has cut \$3000 worth of lumber from it, including 30 circular dining-table tops worth \$75 each. Rings of the tree indicated that it was 527 years old, according to forestry experts.

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A Tribe of Asiatic Indians Immune to Snake Bites

LARGE shipments of snake venom from India led a curious English newspaperman to ascertain how the venom was obtained. He went to the sundarbunds at the mouth of the Ganges, the sacred river of India. There he discovered a whole tribe of most remarkable snake catchers.

They wander about in boats on the marshes, the home of the most venomous of Indian snakes, the cobra and the krait. Eighty per cent of the tribe are women, who handle the poisonous reptiles as freely as the men. The whole tribe seems to be immune to snake bites that would kill an ordinary person within a few minutes. To the journalist's horror the women let the snakes bite them again and again on their faces, but with no disastrous consequences.

The natives lure the snakes from their holes with music. The reptiles seem unable to resist the monotonous music of the reed pipe or the gourd. They go as near to the player as they can, then sway to the rhythm of the music. The piper plays faster and faster, running up as high in the scale as he can in a great burst of music, then suddenly breaks off at the top note.

The snake remains motionless, as if paralyzed. Calmly walking up to it, the piper catches hold of it under the head and pushes it down in his basket.

None of the tribe can be induced to kill a snake, since they all believe that they will lose their strange immunity if they should injure one of the reptiles. Their immunity probably comes from inoculation through centuries of contact.

Huge Meteorite from Greenland

A SHIP sailed into port at Aberdeen, Scotland, recently bearing a strange load—a seven-ton rock said to be worth half a million dollars. It was a gigantic meteorite on its way to a museum in Copenhagen, Denmark.

Doctor Knud Rasmussen, an explorer of the Far North, discovered the huge meteorite in 1918 in an out-of-the-way place in Greenland, 16 miles inland. Getting it out and sending it to Denmark was too difficult a task at that time. It took the united efforts of 170 dogs to drag it, as its great weight constantly broke through the ice.

This meteorite is said to be the third largest in the world. The two bigger ones are in America and England.

Remove Your Glasses in China

TO BE polite in China, always remove your spectacles when greeting a social superior. The Chinese to a considerable extent still hold spectacles in superstitious reverence, reports Dr. James E. Lebensohn, medical historian.

The tortoiseshell frame comes from a sacred animal, while the lenses are made of lucky stones found in the sacred mountains and ground with sand from the sacred rivers. Glasses are worn not only for visual defects and for all sorts of ocular ailments, but for good luck.



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frequently thought that such devitalizing pains and irritations as Sciatica, pains in the back, legs and feet, nervousness, insomnia, lack of physical and mental vigor, were simply signs of approaching old age. Too often and without understanding the man will give up and resign himself to the belief that vitality is lost permanently.

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Insulating Your House

(Continued from page 76)

for themselves, especially in a time of coal shortage. But you probably know as much about that angle of the question as I do."

After studying the various possibilities, Marks decided that the best and quickest thing for him to do was to apply a fairly thick, wool-like insulating material between the rafters so as to leave an air space between them and the roofing boards above, and then, when he was ready to finish the attic, apply wall-board so as to inclose an additional air space between it and the insulating material.

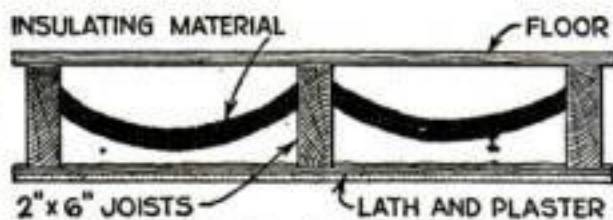
"Won't you come over at the first convenient opportunity and help me figure out how much material to order?" he asked Gorman, and received a hearty promise.

WHEN Gorman went over to see the attic the next afternoon—a Saturday—he learned that Marks already had found what insulating material the local lumber dealer carried and that both the roll insulation and the wallboard were of a width to suit the spacing of the rafters and studs so that little waste and not a great deal of cutting would be necessary.

"Oh, it is a clean, easy job, putting up these insulating materials," Gorman said. "I can't comprehend how people living where winters are severe can go ahead year after year burning nine, ten, eleven or even twelve tons of coal when such a little effort would cut down their coal consumption to perhaps seven or eight tons—seven is all I burned last year."

They were walking around the attic, taking measurements, when Gorman suddenly stooped with an exclamation of astonishment.

"Why, here's another reason you're wasting coal! Look at this! The opening



How 17-in.-wide insulating strips are placed between floor joists to divide air space in two

between these studs seems to go all the way down to the first floor."

He picked a bent 20-penny nail off the wall plate and dropped it down. It seemed to fall a long way.

"I'll bet it went down to the cellar," he said. "That's the case in quite a few houses that have been built hastily or for speculation. The construction is such that the space between certain pairs of studs, that is, the upright members of the house frame, runs all the way from the cellar to the attic and is open at both ends so that it is just like a chimney flue. The heat from the cellar goes straight up into the attic.

"Furthermore, ordinary plaster walls are quite porous, so that a good deal of heat is conducted through them into the open spaces and is carried briskly up into the attic. There ought to be fire-stopping

(Continued on page 156)

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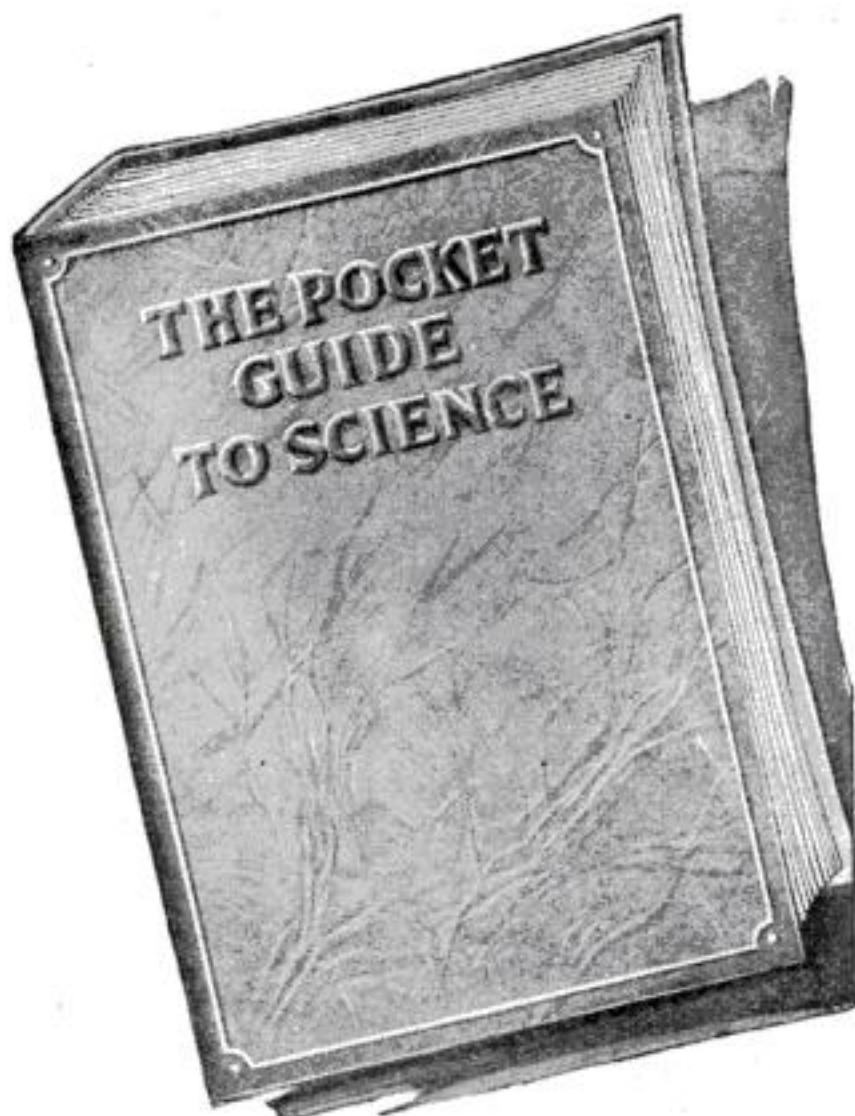
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Insulating Your House

(Continued from page 154)

to break up each of these spaces into compartments, but, of course, you can't put them in now that the house is built. These openings, however, all should be closed with insulating material or blocks of wood. Thick wallboard is good because it can be cut so easily to fit. Convection will still take place, the air rising up the inside or warmer surface and being compelled consequently to flow down the outside surface, when conduction to the outside will take place, but you still will be much better off."

WHEN they were through in the attic they went down into the cellar and found that, as Gorman suspected, the construction at the sill just above the foundation was such that the air from the basement could escape upward between the studs, and, no doubt, in certain places it had an unimpeded passageway to the attic. As they were going upstairs again, Gorman remarked that the cellar seemed small in proportion to the house itself.

"Yes," said Marks; "the builder must have tried to save a little expense in excavating because part of the dining-room has no cellar under it."

"Well, I hope he took some pains to insulate the floor over the section," said



Insulating an attic by the method that John Gorman suggested

Gorman, "because that's another place where a lot of cold can get in. If I were you I would try to get under the floor some way—"

"That's easy because there's a sort of blind window in that section of the foundation," interrupted Marks.

"Then put some insulation underneath. Of course, it would have been much easier to put that in before the floor was laid; it is a very simple matter to put mineral wool or something like that under a new floor. If you ever plan to have an oak strip floor laid in the dining-room, you could place a layer of insulating material or insulating lumber over the old floor first. That is being done frequently in good houses nowadays because it deadens sound as well as keeps out cold."

"I SUPPOSE I also should do something with the floor of this window projection," said Marks, as he led the way into the living-room. "It juts right out from the foundation and has nothing at all under it."

Gorman put his hand down on the floor boards.

"I can tell by the feel that a lot of cold is coming up through the floor," he said. "When you get a reasonably mild day to work outside, see what you can do from underneath. Put an insulating layer below the joists, if possible."

The figuring on quantities and prices done, Marks saw his friend to the door.

(Continued on page 158)

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By H. L. HODGSON

Illustrated by

JOHN A. MAY

THE "Limited" was held up by a freight wreck ahead. I was marooned in a small but prosperous manufacturing town with but little prospect of getting out before midnight. Tired, after a hard day's work, I had just about decided to take in a movie, when the town band sailed by at the head of a torchlight procession.

Upon inquiring I learned that the local American Legion Post was celebrating the opening of its handsome new building. Forgetting the movies, I followed the crowd and experienced one of the biggest and happiest surprises of my life.

The lion of the evening was my old schoolmate, Bill Woods. Bill held the audience spellbound for three-quarters of an hour with one of the best speeches I have ever heard.

When the meeting broke up, I lost no time in pushing my way through a group of ardent admirers to Bill's side and later, as he walked to the railroad station with me, my curiosity got the best of me.

"BILL," I said, "the last time I talked with you it took you almost five minutes to answer yes or no, yet tonight you made a most remarkable address. How in the world did you do it?"

Bill laughed. "It's a long story—old man—but a mighty interesting one."

"Up until about a year ago I was a stammerer of the worst kind. Do you remember in school how the fellows made fun of me? I guess that was one of the reasons why I got poor marks. I knew my lessons, but was always afraid to get up on my feet and recite. The only tests I could ever pass were written ones."

"When I got out of school I came up here and went to work for the Johnson Company. I don't know how I ever got the job or held it, because every time I was asked a question, I got nervous and before I could make a reply my questioner would turn to someone else for the information he desired. I always knew what I wanted to say, but somehow I couldn't get it out."

"Well, other fellows, who did not know the business half as well as I did, began to pass me in both salary and position. While they moved up, I stood still at the same old job and earning the same small beginner's salary."

"I couldn't afford to make a stand for myself before the boss. If I had I would have been fired. The Johnson Company had no important places for men who couldn't talk. I had big ambitions, was vitally interested in the business and was sure I could make good on the sales force if only I could learn to speak distinctly. In my day-dreams, I pictured myself out on the road putting across big sales, earning big money and holding down a real job. Then I would awake and be more miserable than ever."

"Didn't you ever try to be cured?" I interrupted.

"Time and time again—I never missed even the slightest chance," he replied. "But it seemed of no use, and finally I concluded I could never be cured."

THEN one day, one of the fellows in the office showed me a letter from a friend of his. This friend, a short time before, had stuttered and stammered just as I did then. The letter told how he had been entirely cured by a new scientific method at a regular school for stammerers and stutterers.

"At first I did not pay much attention to it. What was the use? I had tried one so-called cure after another without result. Over and over again my hopes had been aroused, but each time I had failed and as a result had become more despondent than ever."

"But this fellow insisted that the Bogue Institute was entirely different. He told me his friend had also tried all kinds of reliefs without results, but that he had been absolutely cured in a few weeks by attending classes under Mr. Bogue."

"Well, a few days later I saw one of



"I lost no time in pushing my way to Bill's side"

the Institute advertisements in a magazine. After reading it I sent for full information with the understanding that I was not obligating myself in any way.

"In a few days I received all their descriptive literature and a catalog. I learned that Bogue Institute at Indianapolis was a resident school with dormitories, classrooms and a regular schedule of work just the same as any other boarding school or college."

"Another thing that interested me was the fact that the founder of the Institute, Benjamin N. Bogue, had stuttered and stammered for twenty years and had first worked out this scientific cure for himself. Once cured of the trouble that had made his own life so miserable, he was too big-hearted to stop. So he decided to help others. Soon he had a large class and, spurred on by wonderful results, he started the Bogue Institute and made the scientific cure of stammerers his life work."

"The catalog showed pictures of the school and there were numerous letters written by graduates who had been cured. After carefully looking over the literature I became convinced that at least this was a more reasonable idea than any I had ever tried before."

"With the books and literature, I also found a diagnosis blank. This was a regular diagnosis form, but very easy to fill out. On it I wrote all my symptoms and a general history of my particular case and sent it in."

"A few days later I received a personal letter from Mr. Bogue in which he completely and correctly diagnosed my case from the questions I had answered. He seemed to thoroughly understand my condition and once again I entertained hopes of being cured."

SO I wrote and had my name placed on his registry list. I found the school to be always crowded. But then the courses were short and with the

cure and graduation of students new vacancies were occurring constantly.

"In about two weeks after I had sent in my application I received a letter to report at the Institute on a certain day."

"Then for once I mustered up nerve enough to go to the boss and ask for some time off. When I finally managed to make my request plain he was more than anxious to let me go. 'Good luck to you,' he said, 'I hope you will be completely cured.'"

"Well, to make a long story short, six weeks after I enrolled under Mr. Bogue, I left his Institute absolutely cured of the affliction that had made so many years miserable for me. Not only was I able to talk without stuttering or stammering, but I had learned how to speak correctly. I had mastered the art of becoming a convincing speaker! Talking became a pleasure instead of misery for me."

"Best of all, my six weeks at Bogue Institute were really enjoyable. The Institute is founded on the soundest of principles and Mr. Bogue is a big-hearted man who is deeply interested in his work and gives every student his individual attention."

"After I returned to work, advancement came rapidly. At last I was able to cash in on the things I had learned about our business. I asked for a chance to go on the road. Luckily there happened to be a vacancy at that time. I was given the opportunity I had dreamed of so long and I have made good. My salary was raised twice in nine months, and three months ago I was made sales manager with headquarters at the new plant here."

IF YOU stutter or stammer, do what Bill Woods did. Benjamin N. Bogue, who cured himself and hundreds of other men and women, boys and girls, can cure you!

The Bogue Institute was established a quarter of a century ago. It is an old institution, founded on good sound principles and being run on honest, business-like methods. Results, under the Bogue method, are guaranteed.

The average student has remained at Bogue from three to eight weeks. It is a resident school—not a mail order organization. The school surroundings are pleasant and comfortable. The faculty is composed of experts in their line of endeavor.

If you stammer or stutter, find out for yourself what the Bogue Institute can do for you.

Without obligating yourself in any way fill out the coupon below. By return mail you will receive full information regarding this sure, scientific cure for stammerers and stutterers.

Or if you do not stutter, but know of someone who does, either see that this story of Bill Woods is called to his attention or send the Bogue Institute his name and address. Your name will not be mentioned in any way. And the Bogue Institute may be the means of opening up a whole new world for him.

BENJAMIN N. BOGUE

7526 Bogue Bldg. 1147 N. Illinois St.
Indianapolis, Ind.

Without obligation on my part, please send me full information regarding the Bogue Institute and the new scientific cure for stammerers and stutterers.

Name.....

Address.....

Great NEW Invention

for seekers of

Health Power Beauty



Elco Health Generators at last are ready for you! If you want more health—greater power to enjoy the pleasures and delights about you, or if more beauty is your desire—write! Ask for the book on these inventions which has just been prepared. It will be sent to you without cost. It tells you how Elco Health Generators aid you in leaving the lethargy and hopelessness of bad health and weakness behind forever. Re-vitalize yourself. Bring back energy. Be wholly alive. Write today!

10 Days FREE Trial.
Write for FREE Book.



These great new inventions generate Violet Ray, Vibration, Electricity and Ozone—combined or separate.

Free Trial

They operate on the electric light in your home or on their own motive power at less than 50 cents per year. Elco Health Generators are positively the only instruments which can give you in one outfit Electricity, Violet Ray—Vibration and Ozone—the four greatest curative agents. Send the coupon below. Get the Free Book NOW!

For All These:

Rheumatism
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Insomnia
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Do not put this paper down without sending the coupon. Don't go on as you are with pains and with almost no life and energy. You owe it to yourself to be a better man or woman. You were put here to enjoy life—not just to drag through it. So do not rest another day until you have put your name on the coupon here. That will bring the whole story of these great new inventions. Do it today—now.

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Please send me your free book, "Health—Power—Beauty," and full information of your 10-day Free Trial Offer.

Name.....

Address.....

Health
Power
Beauty

Insulating Your House

(Continued from page 156)

Both men glanced at the falling mercury in the porch thermometer.

"Getting colder all right," said Gorman, and he smiled as a whimsical idea struck him. "Don't forget, old man, this very same insulation you're going to put in now to keep the heat in, will help do just the opposite in the dog days next summer. Then you will be wondering why your bedrooms upstairs are so cool."

"That's the last thing I'm worrying about now," laughed Marks, as he said good-bye.

It occurred to Gorman later that he could have added a good many other suggestions about insulation—the extra resale value of a well insulated house; the use of insulation for improving garages, especially those made of sheet metal; the especial value of insulation on windy days when the cold is penetrating; the curious kinds of insulating materials that are manufactured, such as quilts made of eel grass, but he knew that any one who started thinking about the subject soon would realize the urgency of improving as far as practicable the cold- and heat-resisting qualities of the walls and especially of the roof of his home.

As in the case of other building materials, it is desirable, if not essential, to purchase insulation through your local lumber dealer who, if not already supplied, will get one of the standard makes for you. If you wish to use a wallboard type of insulation in the attic, you will find instructions for its application in the first and second articles of the series now being published in the Home Workshop on "An Unfinished Attic" (September and October, 1925, issues), and in Part 5, which appeared last month.

Saving the Leaves of a Wall Calendar for Reference

EACH SHEET FOLDED ONCE



IF YOU use the ordinary type of wall calendar in your home, office, or shop and have occasion to look up dates in months gone by, you will find the method illustrated above a convenient one for preserving the sheets. Instead of tearing each sheet off at the end of the month, fold it in two and turn it back against the cardboard backing. Fasten by means of a paper clip, which can be inserted through a slit in the cardboard.—F. W. H.

ONE expedient for lessening the ravages of rust, which spoils so many tools kept in cellar workshops, is to place a large lump of unslaked lime in the bottom compartment of the toolchest. The lump absorbs much of the surplus moisture. It should be changed at least twice a year.



What Caused It?

Here is a remarkable picture of the greatest tornado that has swept across the West in recent years; it's only one of the scores of extraordinary pictures in the Popular Science Library.

Do you know what causes the dramatic, disastrous freaks of nature—tornadoes, cloud-bursts, fog, and lightning? You should know. Do you know the probable reasons for the great Santa Barbara earthquake? You can know. Send for the free book, "The Wonderland We Live In." It is the key which will unlock for you a storehouse of the world's strangest and most wonderful secrets.

Science made thrilling for YOU

in the wonderful new Popular Science Library

"Science is thrilling for the scientist," said Garrett P. Serviss. "Let's make it thrilling for everyone." And so he edited a great library of sixteen volumes touching every scientific subject, each subject written by a recognized authority. Mr. Serviss himself is a renowned scientific writer, and the men he selected to help him have each won fame in their respective branches. Furthermore, they are men who have been able to tell about their subjects in a popular absorbing way. And now, to complete this great achievement, the work has been published by P. F. Collier & Son Company, at a price so low that it is available to all. The Popular Science Library answers every possible question about science. It includes every scientific topic from the creation of the world to the marvels of modern invention. It tells in simple terms the fascinating story of the heavenly bodies—why there are "zones of silence" in the atmosphere—what makes wind, dust, and smoke.



Scientific fact—as gripping as a novel

The Popular Science Library is a complete reference work, essential to every intelligent American household. But its value goes far beyond this. Each book reads like a novel, telling with thrilling power the marvelous story of how man has tamed the elements and charted the infinite. Here you will find your favorite subject authoritatively and vividly discussed, and you will find new subjects that become more and more fascinating to you. Startling facts, useful facts, practical advice, food for thought, and interesting conversation.

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Send for this RADIO BOOK FREE

**The World's Largest
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Wonderful Book FREE!**

64 illustrated pages containing thousands of bargains in radio sets, semi-finished sets and radio kits of all styles, sizes and approved circuits. 5-tube sets as low as \$29.50. Beautiful models of the very latest designs and types. Elaborate console models with loud speakers built right in cabinets of genuine mahogany and walnut. All sets guaranteed. Coast to coast receiving range. Also contains everything in radio supplies, including batteries, chargers, loud speakers, transformers, condensers, rheostats and any other parts you may want for improving your set or building a new one. Guaranteed saving to you of $\frac{1}{3}$ to $\frac{1}{2}$.

The Biggest 5-Tube Value on the Market

Positively the world's greatest 5-tube radio bargain. Regular \$75.00 value. Our large quantity production enables us to sell this set for only \$29.50, fully built and wired in beautiful mahogany cabinet of latest design with sloping Bakelite panel of Satin finish, handsomely etched and engraved as illustrated. Constructed of the finest low-loss condensers, coils and sockets. Bakelite baseboard panel and dials. Price for set only..... **\$29.50**

Transportation charges extra. Shipping weight 25 lbs.

This set with all Accessories, including the famous American Bell Loud Speaker with adjustable unit, 2-45 volt "B" batteries, one guaranteed 100 Ampere Hour storage "A" battery, cable for battery connection, 5-201A tubes, Aerial and ground equipment, and everything complete ready to set up and operate. Nothing else to buy. Price..... **\$59.75**

Transportation charges extra. Shipping weight 100 lbs.

Order Direct From This Page! Save $\frac{1}{3}$ to $\frac{1}{2}$. Sets on this page are typical examples of bargains throughout our catalog. Our guarantee protects you. Money cheerfully refunded if you are not satisfied. Write your order and prices plainly. Send post office money order or bank draft for full amount to insure safety. Refer to any bank or commercial agency regarding our reliability.

Columbia Grand 5-Tube Console Set

\$57.95



Console Radio with built-in loud speaker and adjustable unit. Has compartments for storage "A" and "B" batteries, battery charger, radio book of instructions, etc.

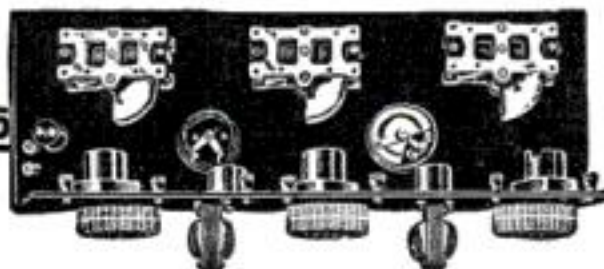
Beautiful Walnut Cabinet in two-toned effect. Two door panels inlaid with highest grade burl walnut. Cabinet is 39 inches high. Top measures 13x37 inches. Equipped with high-grade built-in loud speaker with adjustable unit. Large, roomy interior for holding all batteries, books, etc. The Columbia Grand is a 5-tube tuned radio frequency receiver. Coast to coast receiving range. Tune in stations desired—very selective. Has latest type, low-loss condensers, coils and sockets. Bakelite baseboard, sockets and dial knobs. Dials are beautifully etched in gold on walnut finish bakelite panel. Price for set only, fully built and wired—\$57.95.

Transportation charges extra. Shipped by freight or express.

This set with all accessories, which include 2-45 volt "B" batteries, one guaranteed 100 ampere hour storage "A" battery, 5-201A tubes, multicoiled cable for easy battery connection, aerial and ground equipment, instructions for setting up and operating—everything complete, nothing else to buy—\$84.95

Semi-Finished 5-Tube Radio Frequency Set

\$18.75



This special offer is astounding the radio world. Coast to coast reception on loud speaker. Low-loss condensers and sockets. Highest quality transformers. Bakelite rheostats. All wiring concealed under Bakelite baseboard. 7x18 panel—fits into any standard 7x18 cabinet. Complete instructions for operating. Guaranteed saving to you of \$50.00. Price of set all mounted, \$18.75. Cabinet of same model as American Radynola pictured above \$5.65 extra.

Catalog includes list of broadcasting stations, general radio information and facts about our free service division. Write for it today.

RANDOLPH RADIO CORPORATION
159 N. Union Ave. Dept. 245 Chicago, Illinois

Our line is complete, includes all popular sets, such as Superheterodyne, Neutrodyne, Ultradyne, Reinartz, Regenerative, Radio Frequency, Brown-Drake, Super-Heterodyne Reflex and all other latest circuits. Kits, sets and parts by well-known manufacturers such as Frost, Howard, Baldwin, Brandes, Western Electric, Columbia and others.

ULTRADYNE

Complete parts for 8-Tube Ultradyne receiver, without cabinet, complete with blueprint, instructions and diagrams

\$45.85

NEUTRODYNE

Genuine Licensed Neutrodyne kit of parts come fully assembled on the panel and baseboard with complete instructions ready to wire

\$29.75

ULTRA-AUDION

One-tube Ultra-Audion. Wizard of radio. Fully assembled and ready to wire, with instructions

\$6.35

COCKADAY

3-tube Cockaday kit of parts, fully assembled on panel and baseboard ready to wire

\$15.85

BROWNING DRAKE

4-tube complete low-loss parts

\$32.40

REMLER 8-TUBE SUPER HETERODYNE

Complete parts for Best 45 Kilocycle Super-Heterodyne Genuine Remler parts

\$49.50

HARKNESS

2-tube reflex kit of parts, fully assembled on panel and baseboard, ready to wire, complete instructions

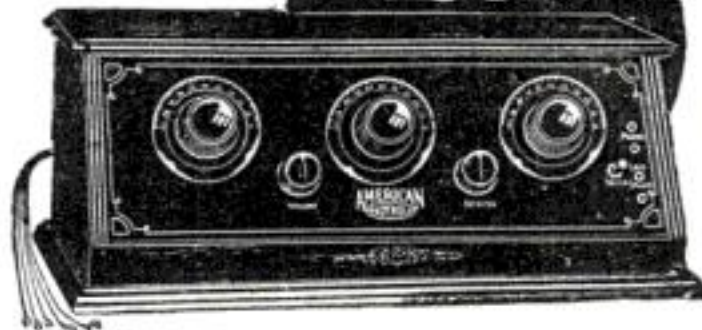
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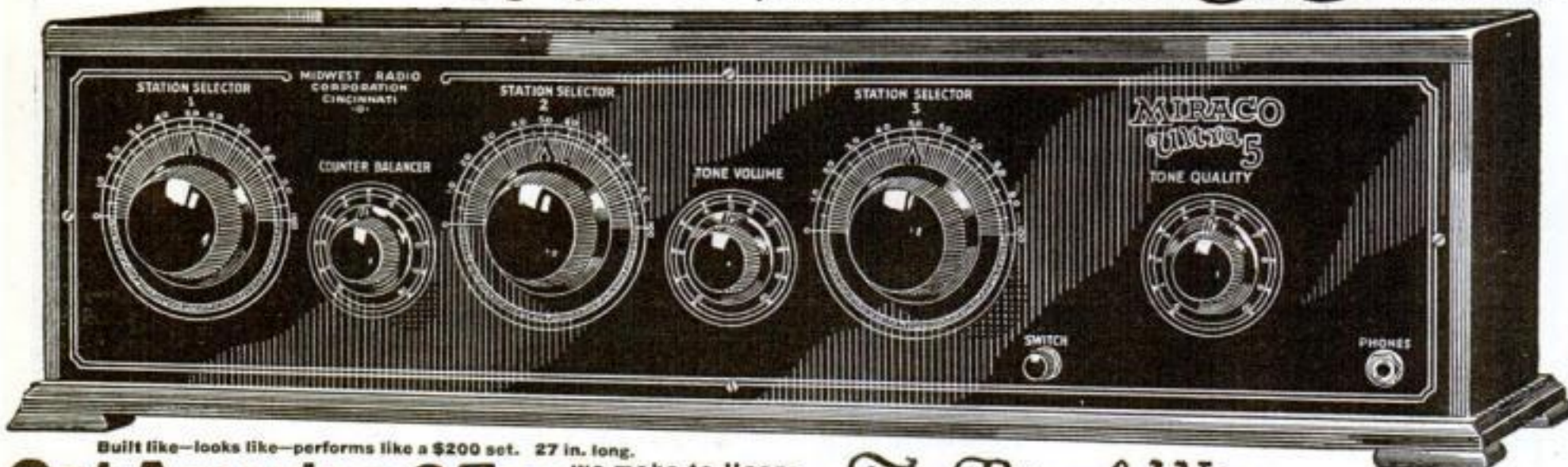
1926 Catalog of RADIO BARGAINS Save $\frac{1}{3}$ to $\frac{1}{2}$

AMERICAN RADYNOLA 5 TUBE SET

\$29.50



Now only
"Just a slight turn of the dials and \$59.50
 with all Chicago local stations
 broadcasting I get everywhere outside". **GET SPECIAL OFFER**
Retail



Built like—looks like—performs like a \$200 set. 27 in. long.

Get Amazing Offer

We make to Users who will demonstrate our set to friends.

MIRACO RADIO GETS 'EM COAST TO COAST

Notice!

Enormous demand for the celebrated Miraco Ultra-5 (resulting from its many enthusiastic users so highly recommending it to their friends) enabled us to add hosts of costly new features, latest refinements and up-to-the-minute improvements such as you might expect to find only on the newest sets selling at much higher prices. So the Improved Ultra-5 for 1926 is even a better set—a more beautiful set—a more selective and more powerful set—incredible as this may sound!—for less money than ever before.

COAST TO COAST RECEPTION VERIFIED BY USERS

Reports from Ultra-5 users everywhere leave little for us to add. These are only a few of the many in our files and which we receive daily. Send coupon for plenty of additional proof. Let testimony of users instead of high-sounding claims convince you.

CALIFORNIA THE FIRST NIGHT
 Received KFI Los Angeles, Cal., and Mexico City the first night, besides about twenty more on my Ultra-5. Ray K. Eaton, Ohio.

CANADA TO THE GULF AND COAST TO COAST
 I sure do like the Miraco Ultra-5. I got from CKY, Winnipeg, Canada, to WSMR, New Orleans, and from WGY, New York, to KFI, California, last night. Chas. M. D. Bentonville, Ill.

CUTS THROUGH THE LOCALS
 My Set certainly cuts through the locals. For a good well made set and good workmanship it can't be beat. I know if there is anything on the air, my Miraco Ultra-5 will bring it in. J. H. A. Pittsburg, Pa.

PRaises ITS CLEAR TONE
 Received the Ultra-5. It is working fine and in fact is the clearest toned outfit I ever heard. I have gotten 40 or more stations including KFI, Los Angeles, Calif. W. A. G. Potwin, Kansas.

CALIFORNIA HEARS CINCINNATI THE FIRST EVENING
 I wish to thank you for your promptness in shipping, and the perfect condition in which the Ultra-5 arrived. I have proven your promises to be absolutely truthful. The tone, volume, and distance are excellent. The first evening I enjoyed a concert from Cincinnati. E. E. S. San Francisco, Cal.

NEW YORK GETS 'EM COAST TO COAST
 I have one of your Miraco Ultra-5 radios and it's working fine. I get all stations from coast to coast and would like to be one of your agents. Kendrick, E. E. Cooperstown, N. Y.

OUTPERFORMS ALL OTHER SETS IN HIS LOCALITY
 There is not a radio in this neighborhood that can compare with the Miraco Ultra-5. J. H. Alden, Iowa.

COAST TO COAST THE FIRST NIGHT
 The first night I had the Miraco Ultra-5 I got Santa Catalina Island on the Pacific Coast, also New York and last night Chicago. W. O. K. Lorton L. W. Hot Springs, S. D.

TENNESSEE HEARS CALIFORNIA
 Received my Ultra-5 O. K. Never saw a set packed so well. As to performance, it's just simply wonderful. No trouble for me to get Los Angeles, California, and without any interference. Wonderful tone and easily operated. W. F. T. Adamsville, Tenn.

AS GOOD AS IT LOOKS!
 I received the Ultra-5 in fine shape. It is a beautiful piece of furniture and works just as good as it looks. Arthur E. A. Greenock, Pa.

YOU'LL WANT IT, TOO!
 The Miraco Ultra-5 you sent me is so satisfactory I would like the agency for it. Wm. E. C. Torrington, Conn.

HAS EXCEPTIONALLY FINE TONE
 My Ultra-5 works fine. My friend liked it very much and said it certainly is a good set and has an exceptionally fine tone. I would like to sell your sets in my spare time. H. M. S. Stuttgart, Ark.

TUNES OUT POWERFUL NEARBY STATION AND GETS DISTANCE

We are surely having fine luck with the set. We get everywhere with all Chicago stations broadcasting. We now live about one mile from WGN, the Drake Hotel. It has a wavelength of 370 meters and on all other sets around here they are not able to get out or get any other station without also hearing WGN. But with our Miraco 5 we don't have any trouble. Just a slight turn of the dials and it isn't there. We can get outside any night better than our neighbors. Here are some outside stations we have heard in four nights on the loudspeaker: WJJD, WORD, WCED, WLBB, WSMR (New Orleans), WSAI, WOC, WSM, WEAF (New York City), KFKX (Gastonia, Neb.), KOA (Denver), KFNE, KUSA (Pittsburg), WHAS, WLW, WARD, WLBB, WLR. Everyone that hears the Ultra-5 is in love with it and says it is so clear. Herman C. Chicago, Illinois.

PENNSYLVANIA HEARS CALIFORNIA TO CUBA
 Your Ultra-5 works splendidly from Los Angeles to Cuba, everything came in fine. Roy H. Rochester, Pa.

SOLD IT THE DAY RECEIVED
 I received my Miraco Ultra-5 a few days ago and sold it the very same night. The buyer is very much pleased. It sure works fine. Jacob K. Beulah, N. Dak.

57 STATIONS IN FIRST FEW DAYS
 Our Ultra-5 arrived in fine shape. Had no trouble at all hooking it up. Set it up about 11:00 A. M. and heard several stations. Including tonight we have gotten 57 stations without just trying to get new stations for we listen to the different programs as we get them. Claude L. Willow Lake, S. D.

IOWA HEARS MEXICO CITY
 We have given the Ultra-5 quite a thorough tryout and are very well pleased with its performance. Alongside of an expensive receiver its performance on tone, volume and distance are more than we expected. We pulled in KFI, Los Angeles, Cal., with many others the first evening and last night Mexico City came in clearly on the loudspeaker. Lewis W. H. Greenville, Iowa.

PRaises ITS CLEARNESS
 I received my Ultra-5 in fine condition and am very pleased with it. I really think that it is the best radio I have heard. Everything comes in so clear and plain. Sydney C. M. Ft. Harrison, Mont.

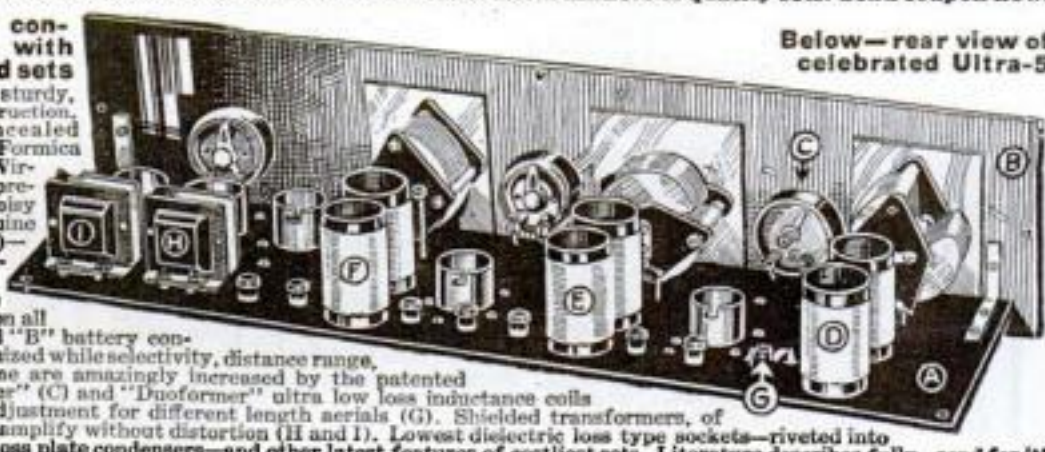
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Amazing Special Offer!

The Powerful New
MIRACO Ultra-5
 Guaranteed by One of the Oldest Radio Builders
 Tested and Approved by Radio's Highest Authorities
[ULTRA SELECTIVE FIVE TUBE SET IN MAHOGANY CABINET]

You can either *save* or *make* a lot of money by sending coupon today for our **Amazing Special Offer**. It will astonish you. Just say you'll let your friends listen to the powerful new Miraco Ultra-5 in your home and we ship it to you **ON APPROVAL** at the wholesale price—*satisfaction unconditionally guaranteed*. The wonderful selectivity, long distance range, clarity of tone, power and volume of this famous set—plus its beauty of appearance and splendid construction—will sell it to your friends. Big profits easy for you—accepting their orders. No salesmanship required—no agreement to sign. You can also buy accessories at wholesale from us. Even at its retail price this latest improved big beautiful 1926 model Miraco Ultra-5 is an astonishing bargain, in the opinion of radio authorities. Remember, too, that each Miraco comes *completely built, thoroughly tested and fully guaranteed* by the great Midwest Radio Corporation—one of America's oldest, reliable and most successful makers of quality sets. Send coupon now.

Compare its construction with highest priced sets

Note the neat, sturdy, high-class construction. All wiring concealed under genuine Formica base panel (A). Wiring is flexible to prevent broken or noisy connections. Genuine Formica panel (B)—handsomely gold-etched on front. Oscillations are easily controlled on all wave-lengths and "B" battery consumption is minimized while selectivity, distance range, clarity and volume are amazingly increased by the patented "Counter-Balancer" (C) and "Duoformer" ultra low loss inductance coils (D, E and F). Adjustment for different length aerials (G). Shielded transformers, of celebrated make, amplify without distortion (H and I). Lowest dielectric loss type sockets—riveted into base panel. Low loss plate condensers—and other latest features of costliest sets. Literature describes fully—send for it!



Below—rear view of celebrated Ultra-5

AGENTS! DEALERS!

Write for the new Miraco proposition. Nation-wide use and popularity of Miraco sets, coupled with their amazingly low prices make them wanted everywhere.



Other Miraco Long Distance Sets \$13.75 up
 Get **Special Offer!**

Remember you are dealing with a big, responsible corporation—one of the oldest and most successful in the industry, a concern which has grown to immense size through the recommendations of satisfied customers—when you buy a Miraco. Absolutely no risk on your part. All Miraco sets work on storage or dry batteries, are easily connected, operated, and logged. Approved by Radio's Highest Authorities. Unmatched values! Let testimony of users convince you. Send coupon for complete literature and **AMAZING SPECIAL OFFER!**



All the Proof you want is waiting for You!

Reports from hosts of users in every state prove Miraco sets—at rock-bottom factory prices—outperform sets costing up to three times as much. Send for latest literature, **SPECIAL OFFER** and plenty of additional testimony leaving no doubt that "Miraco Radio Gets 'em Coast to Coast."

MIRACO RADIO GETS 'EM COAST TO COAST

MIDWEST RADIO CORPORATION
 Pioneer Builders of Sets

408-S East Eighth Street
 Send free literature, **AMAZING SPECIAL OFFER** and all particulars regarding your big money-saving proposition on Guaranteed Miraco Sets and all radio supplies.
☐ Agent ☐ User ☐ Dealer.
 NAME _____
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“The fragrance of pipe tobacco makes me wish I were a man”..... *Bob Daniels*



Guaranteed by
The American Tobacco Co.
INCORPORATED



*If You'll Use This
New Invention*

I'll Guarantee

To Keep You in Razor Blades for Life!

THIS amazing new invention upsets all established shaving tradition. Within 60 days it will revolutionize the before-breakfast habits of over a million American Shavers! KRISS-KROSS marks such a radical advance in new shaving comfort and economy that it deserves to be classed as much more than a stropper. It's a **super-stropper**—a blade **rejuvenator**! Almost literally, it makes a new blade out of an old one every day—makes hundreds of keen, quick shaves blossom where only one grew before. Until you've seen KRISS-KROSS—fitted its sturdy, nick-eled smoothness into the palm of your hand, and tested its uncanny ingenuity, you'll never know how really sensational this introductory offer is!

Astounding Features.

KRISS-KROSS employs the diagonal stroke, same as a barber uses. Never before has any one captured the secret of successfully reproducing this stroke automatically. Eight "lucky leather grooves" do the trick in 11 seconds with a precision it takes a master barber years to attain.



**GET THIS MYSTERY
RAZOR FREE**

Most astonishing razor you ever saw. Really 3 razors in one. Adjustable to any shaving position. Flip of finger makes it straight or T-shape in a jiffy. Novel feature gives sliding instead of pulling stroke. Simply zips through the toughest crop of whiskers. Nothing like it ever on the market before. I'll send you one FREE to introduce KRISS-KROSS super-stropper. Limited offer. Find out about it today!

But that's not all. KRISS-KROSS embodies still another feature that has hitherto baffled mechanical reproduction. It stropps from heavy to light. It's absolutely uncanny how the strokes grow lighter and lighter until an adjustable, automatic jig flies up and notifies you that the blade is ready—ready with the **keenest cutting-edge steel can take.**

No wonder that this super-stropper prolongs the life of any-make blade, single or double edge, for weeks, months and years! Think what it means! No more bother about remembering to buy new blades! No more "raking" with dull ones! KRISS-KROSS, coupled with my startling offer below, solves your blade problem for all time. Keen, velvet-smooth shaves forever. And think of the economy!

No More Blades to Buy!

And now for my smashing offer! To introduce KRISS-KROSS stropper during the next 30 days I am giving with it, **free**, a new kind of razor. This unique razor, with 5 special-process blades, completes the outfit with

which I guarantee to keep you in razor blades for life!

Here's how the plan works—proof that my promise "goes all the way." Use the blades and keep re-newing them with KRISS-KROSS super-stropper. If one of them goes back on you for any reason (except rusting or nicking), return them and I'll recondition or replace them with new ones. No strings. No red tape. I give my amazing guarantee in **writing**. It is an ironclad agreement to **KEEP YOU IN RAZOR BLADES FOR LIFE!**

Send for Full Details.

Write for free information on this astonishing new invention and introductory offer. KRISS-KROSS is never sold in stores. You deal direct with me or my authorized representative. Send for description and full details of this limited offer. It's even more remarkable than I can tell you in this small space. No obligation! Just clip and mail the coupon today!

AGENTS: \$30-\$66 a Day

Make big money with KRISS-KROSS! Free razor boosts sales amazingly. H. King made \$66 one day. C. E. Conklin made \$22 in 2 hours. Others average \$175-\$100 a month. Every man buys on sight. SPARE-TIME workers, OFFICE and FACTORY men make \$6-\$12 extra a day showing KRISS-KROSS to friends and fellow employees. S. Kuntala made \$154 extra working evenings 3 weeks. Unique surprise bonus plan brings big extra profits while you sleep. Most wonderful sales plan ever originated. Get details at once. Check bottom of coupon and mail it tonight.

Sold only Through Authorized Representatives

Rhodes' KRISS KROSS
RHODES MFG. CO., INC.
Dept. B-240, 1418 Pendleton Ave., St. Louis, Mo. **STROPPER**

Rhodes Mfg. Co., Inc.,
1418 Pendleton Ave., Dept. B-240, St. Louis, Mo.
Without obligation please send me full details of your special introductory offer to keep me in Razor Blades for LIFE. Also send me full description of KRISS-KROSS stropper and FREE adjustable razor.
Name.....
Address.....
City..... State.....
☐ Check this space if you are interested in becoming an authorized KRISS-KROSS representative.